SPECIAL 750TH ISSUE! THE ENCYCLOPEDIA OF THE CAR

CAR AND DRIVER

DEC/2017

INTELLIGENCE. INDEPENDENCE. IRREVERENCE.

A 750-HORSEPOWER CELEBRATION

Corvette ZR1

PLUS:
KIA STINGER GT ROAD TEST//
HONDA CIVIC TYPE R VS. FORD FOCUS RS//
AND MUCH MORE!

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SMOKES THE
COMPETITION

THE TWIN-TURBO*
KIA STINGER

TURN THE PAGE FOR MORE ON THE 2018 KIA STINGER

*AVAILABLE 3.3L TWIN-TURBO V6 ENGINE . ALWAYS DRIVE SAFELY AND USE CAUTION.

2018 KIA STINGER

PULL HERE

THE SPECS

VEHICLE TYPE
Front engine,
rear- or all-wheel drive,
5-passenger,
4-door hatchback

BASE PRICE
Starting under $32,000[1]

ENGINES
2.0L turbo-charged 4-cyl.
Available 3.3L twin-turbo V6

TRANSMISSION
8-speed automatic with
5 drive modes

CHASSIS
55% advanced high-strength
steel construction

BRAKES
4-wheel disc brakes with
available Brembo® 4-piston
front calipers and twin-
piston rear calipers

WHEELBASE
114.4 inches

LENGTH
190.2 inches

WIDTH
73.6 inches

HEIGHT
55.1 inches

PASSENGER VOLUME
93.8 cu ft

CARGO VOLUME
23.3 cu ft

TORQUE
260 lb-ft
Available 376 lb-ft

ZERO TO 60 MPH
4.7 seconds[2]

TOP SPEED
167 mph[2]

2018 pre-production Stinger GT with optional features shown. Production model may vary. Expected arrival late 2017 in select markets with limited availability. [1] Model shown priced higher. MSRP excludes taxes, title, license fees, options, and retailer charges. Actual prices set by dealer and may vary. [2] Preliminary performance estimates determined by Kia for Stinger GT. Always drive safely and use caution.

THE STINGER

SMOKES THE COMPETITION

The Kia Stinger is what happens when you let engineers and designers do whatever they want. Give it a turbo? They gave it two.* Rear- or all-wheel drive? Your choice. A 0-60 time of 4.7s and a top speed of 167 mph?* Sans afterburners? Sweet. What about quad exhausts and the sharpest, longest silhouette since shoulder pads were cool? Awesome.

PERFORMANCE. IT'S SERIOUS BUSINESS.

*Available 3.3L twin-turbo V6 engine. Preliminary performance estimates determined by Kia for Stinger GT. 2018 Stinger GT prototype with optional features shown. Preliminary performance estimates for rear wheel drive Stinger GT using Launch Control and equipped with 19" wheels. Production model may vary. Actual results may vary, depending on options, driving conditions, driving habits and vehicle condition. Do not attempt to verify these results on public roads. Limited quantities available in late 2017 in select markets. Always drive safely and obey all traffic laws.

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In This Issue

Car and Driver, Issue No.

Encyclopedia Vehicula

For the 750th issue of *Car and Driver*, we've taken stock of everything the car has given us since we first filtered it through the glint in our eye. We've had a front-row seat for many transformative automotive moments. Over the years, we've even taken part in some of those moments. Accordingly, our 750th is no regular December issue. It is an *Encyclopedia Vehicula*, an A to Z of how the car has changed and how it has changed our world. We hope we didn't miss anything.

WE'VE GOT HIGHLIGHTS: p.010 Aztek—Things get ugly. p.020 Corvette ZR1—A 750-hp machine to go with our 750th issue. p.028 Detroit—Searching for relevance and respect in the 21st century. p.038 Hatches, Hot—Honda's Civic Type R tries to force the Ford Focus RS to tap out. p.048 Infotainment—The things we can't use, the things we don't like, the things that might force us onto a bike. p.054 K-Car—The meek shall inherit the earth and pay back the debt. p.070 Pickup Trucks—A quarter-century later, P.J. O'Rourke checks in on the once humble pickup. p.082 Road Test—With design and quality checked off, Kia now sets its sights on driving dynamics with the new Stinger GT. p.111 Yugo—A car so wrong, it had to be included here. p.112 What I'd Do Differently—An infamous avocado plans his second act on toast.

American Dream, The

by Eddie Alterman

The car was not invented in America, but we made it ours. We're not talking here about technical innovations such as vehicle mass production or interchangeable parts or the electric starter. Those were all America's, sure. Europe can lay claim to just as many automotive achievements—unibody construction, disc brakes, even front-wheel drive. But we invented what the car meant. We were the ones who built our dreams around it.

The car gave Americans the ability to envision ourselves on the road, in faraway places, our destinations wholly up to us. Before the car, most people had never traveled faster than a galloping horse, save for those who boarded trains. But cars were different from trains or even horses because they were completely under our control. And that mattered. Cars enabled and embodied mankind's freedom to dream and do. Cars individuated and empowered us. One could even argue that the idea of space exploration germinated on dusty highways that led to places where we didn't know what we'd find until we got there. The car was the first machine to make us comfortable with the unknown. It made explorers out of all of us.

The car created another kind of comfort, too. When Henry Ford put out the word that he'd pay able-bodied men $5 a day to work in his factory in Highland Park, Michigan, it begat a mass migration out of the agrarian South—upward mobility for the sake of mobility. The wealth created by those factories radiated outward, from the personal to the local to the national. Workers lived near where they worked; spent their paychecks at the bars, bowling alleys, and barber shops near where they worked; and were provided with local medical and dental care, eventually, from where they worked. That expanding wealth created societal prosperity, a middle class of Americans who could pay for the things they made. And those things they made required and stimulated so much commerce, trucking and delivering so many goods to so many places, that they knit the country tightly together into one truly United States.

The car can't be untangled from our country, our growth, our aspirations. It has made us who we are—lazier and fatter, maybe, but also people who know the freedom of self-determination every time we go to CVS.

And, of course, the car can't be untangled from this magazine. In its way, *Car and Driver* has provided those of us who make it with our very own American Dream, and for that, we thank you.

illustration by FLORIAN NICOLLE

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The Audi Q5 represents everything we've learned from building one of the world's most progressive vehicles. So we've loaded our groundbreaking SUV with technology and features that can deliver beyond the norm. Like standard Audi smartphone interface for simple connection with compatible devices,[1] and available rear cross traffic assist[2] that can sense approaching vehicles and apply brakes when needed. Equipped with our 2.0-liter TFSI® engine that can propel you from 0 to 60 mph in just 5.9 seconds, the Q5 leaves the status quo – and the competition – in the dust.[3]
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[3] Always obey local speed and traffic laws.
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A

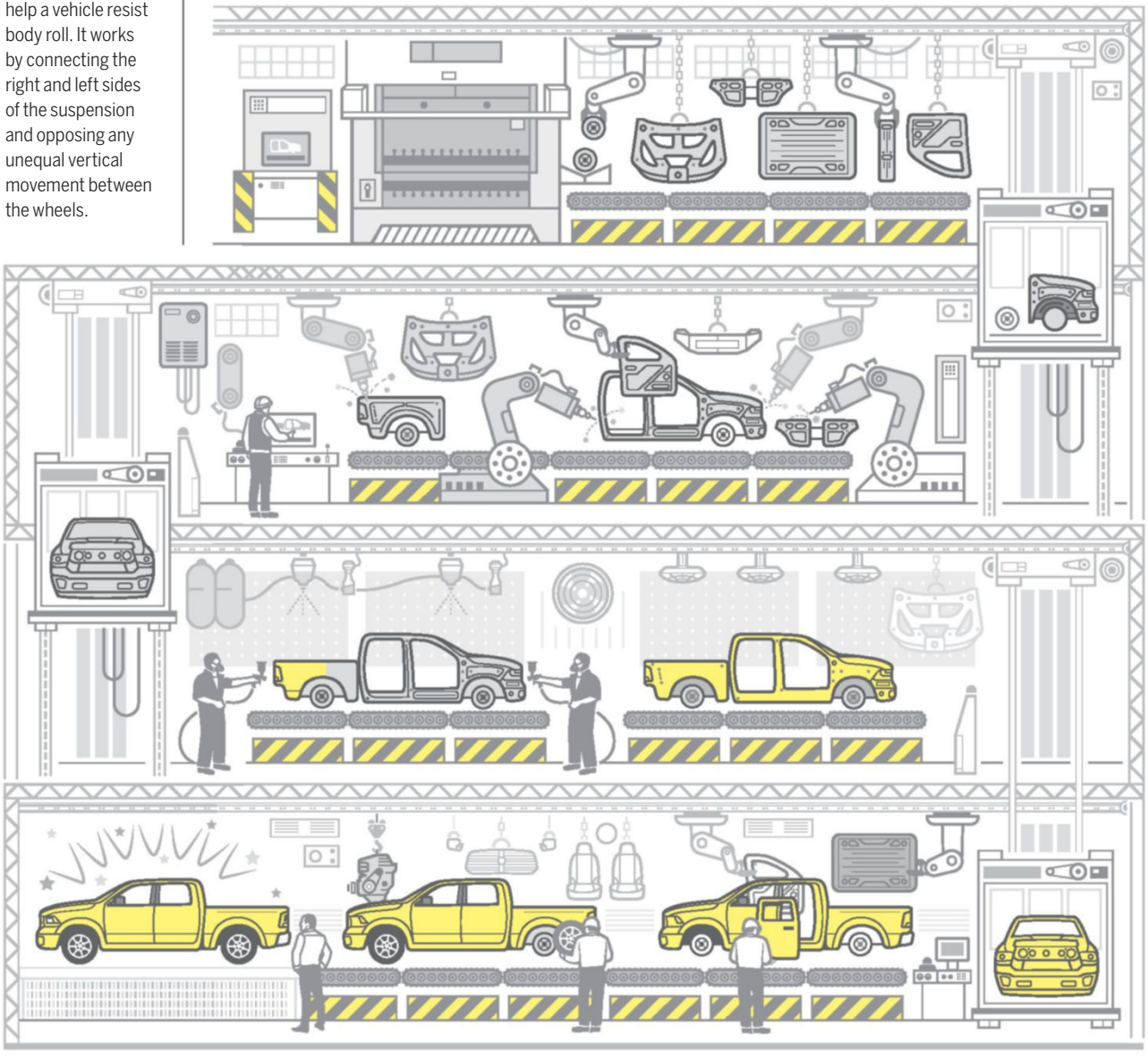
A-Pillar
The forwardmost structural element on either side of a car's windshield that supports the roof.

Anti-Roll Bar
A suspension component designed to help a vehicle resist body roll. It works by connecting the right and left sides of the suspension and opposing any unequal vertical movement between the wheels.

Assembly Line

What it takes to make raw materials into a shiny new truck. by Clifford Atiyeh

Here's an inside look at Fiat Chrysler's stamping and truck plants in Warren, Michigan, where parts for the Ram 1500 Quad and Crew Cabs are made and the trucks are built. The two factories cover more than 5.4 million square feet and produced 332,830 trucks in 2016. That's a brand-spanking-new pickup truck every 94.8 seconds.



Stage One: Stamping
A team of 1732 hourly workers monitors 380 robotized presses and machines that stamp up to 12,000 hoods, roofs, liftgates, floor pans, and fenders per day for the Chrysler Pacifica, Dodge Grand Caravan and Durango, Jeep Cherokee and Grand Cherokee, and Ram trucks. Switching dies to change what's being stamped can take as little as four minutes.

Stage Two: Welding
The 405 robots in this stage precisely weld steel frames and the stamped body panels for the Ram 1500 Quad and Crew Cab pickups. The 565 workers here load parts into the machines, maintain the robots, and assure the quality of the welds and construction.

Stage Three: Paint Shop
Another 652 workers and 42 robots apply a rustproof "e-coating"—essentially a static-cling primer—to the vehicle panels before painting them in one of 28 colors. Every so often, customers interested in peacocking order their trucks in Robin Egg Blue or Detonator Yellow.

Stage Four: Assembly
A total of 2770 workers fit doors, instrument panels, seats, bumpers, wiring harnesses, and that air suspension you can't live without. Machines help with the heavy lifting, but there are no automated robots on duty here, just human hands. Three crews divide up a 120-hour production week, each working one of two 10-hour shifts, six days a week.

illustration by T.M. DETWILER

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Autobahn of America, The

The Big Sky State was once the last bastion of hot, nasty, badass speed. by Josh Jacquot

A Good Thing Gone

Rudy Stanko, a man of many court battles, has had only one that matters to driving enthusiasts. And his win is our loss. Stanko is the man who challenged Montana's "reasonable and prudent" speed law, which stood between 1955 and 1974 and again between 1995 and 1999. It was Stanko's case that gave the Montana legislature reason to impose a highway speed limit.

In March 1996, Stanko was ticketed for traveling 85 mph on Montana State Highway 200. He contested the charge in justice and district courts and was convicted by a jury twice. His second appeal landed the case in the Montana Supreme Court in December 1998. That court, in a four-to-three ruling, reversed the district court's judgment. It called the "reasonable and prudent" clause vague on the grounds that it "impermissibly delegates basic policy matters to policemen, judges, and juries for resolution on an ad hoc and subjective basis . . . " Neither the citing officer nor the attorney general at the time were able to specify a speed that would have been safe at the location where Stanko was stopped. In its finding, the court also stated that the "reasonable and prudent" clause, because of its vagueness, denied defendants due process. It was a shallow victory.

Stanko was never one to be intimidated by the law. His interaction with the courts, both before this case and since, has been prolific. He was found guilty in 1984 of violations of the Federal Meat Inspection Act, a crime for which he was sentenced to six years in prison and fined $70,000. He was also convicted in 2006 of being a prohibited person in possession of firearms and ammunition.

But in Montana, had he opted to pay the $70 fine, he could have made the ticket go away without the violation being recorded on his driving record. And we might still have one state without a numerical speed limit.

Big Bang to 1974
Trilobites blaze across the continental drift for eons before oceans turn to highways that man promptly ruins with speed limits. Only one state, Montana, is left unspoiled with no daytime speed limit. At night, speeds are restricted to 65 mph on interstate highways and 55 mph on two-lanes.

1974
President Richard Nixon signs the Emergency Energy Highway Conservation Act into law. It effectively enacts a 55-mph national speed limit by threatening to kill funding for highways to states not in compliance. Montana meets the letter of the law by fining violators $5 for "an unnecessary waste of a natural resource." But, in spirit, Montana is telling the feds to shove it.

1987
Congress allows states to raise the speed limit to 65 mph on rural interstate highways.

1995
President Clinton signs the National Highway System Designation Act of 1995 into law, repealing Nixon's speed limit and eliminating the highway funding penalty. Montana reverts to its original law, which states that drivers shall operate vehicles " . . . at a rate of speed no greater than is reasonable and prudent." Violations are issued at officers' discretion.

1998
The Supreme Court of Montana, upon hearing the case of Rudy Stanko, decides that the state's "reasonable and prudent" law is unconstitutionally vague and doesn't give drivers fair notice of what speed is fast enough to be illegal.

1999
Montana's legislature sets the state's daytime speed limit at 75 mph.

2015
Montana increases its speed limit to 80 mph on the interstate for both day and night.

PHOTOGRAPH FROM FOUND IMAGE HOLDINGS/CORBIS VIA GETTY IMAGES

Automatic Rev Matching BMW, Cadillac, Chevrolet, Honda, Mini, Nissan, and Porsche offer a feature that automatically raises engine speed to match transmission speed on downshifts, rendering a heel-and-toe downshift [see "H"] unnecessary.

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A

Aztek

The Y2K bug.
by Daniel Pund

Dear friends, we have arrived at a very dangerous moment in history. Please listen closely to what we have to say.

The Pontiac Aztek, that automotive punchline made by General Motors for five long and regrettable years in the early aughts, is on the verge of being considered cool. We blame its recurring role on AMC's insanely good series *Breaking Bad* for getting this ugly ball rolling. Right now, 10 bloggers are spitting out stories about the ways in which the Aztek is now cool. Okay, not actually cool, but "cool" through the process of ironic reassessment. It's the process by which sales of that low-budget swill Pabst Blue Ribbon increased by about 150 percent between 2005 and 2014.

As we pointed out in our "Guide to Automotive Bullsh!t" in July 2017, "If it's mostly cool because it's not cool, then it's not really cool, is it?"

And make no mistake: The Aztek is not cool. It was and shall remain an irredeemable shit heap. It was the antithesis of cool from the start. Pontiac introduced the production Aztek at the 2000 Detroit auto show. For its press conference, the company hired locals to stand around in a mock mosh pit. Some wore rainbow wigs, some carried signs reading, "It's The Versatility, Baby!" and "Aztek 185 hp"—you know, just what you'd see in a mosh pit. At the end of the presentation, the Aztek's head marketing man, Don Butler, jumped into the pit and crowd surfed. This all actually happened in the real world. The Aztek, a blatant minivan-in-drag monstrosity, sat on stage looking like a sad, fat man who'd had his nose cut off. It's so powerfully ugly that a blobfish wouldn't be seen next to it. If you saw something that looked like the Aztek scurry out from behind your fridge, you might have difficulty deciding whether to kill it or kill yourself. After all, if you kill it, you'll still have to live with the knowledge that it existed in the first place. If the infant Aztek were abandoned on a mountainside, it would eventually come crawling back to civilization because even the vultures and ants wouldn't touch it.

The mosh pit at the Aztek's unveiling was every bit as wince-inducing as the shambolic Woodstock '99. Fewer Porta-Johns were lit on fire, though.

It wasn't supposed to go that way, of course. According to designer Tom Peters, the idea bubbled up from GM's West Coast Advanced Concept Center. The notion was to mix the attributes of a Camaro and a Blazer into a wide, low, powerful, off-roadish thing referred to as the Bear Claw. Think of it as a GMC Typhoon with off-road tires.

But the GM overlords determined that the thing should instead be based on the tall, narrow structure from the corporation's minivans. Did this deviation, and the inherent compromises it represented, prevent GM from producing the thing? It did not.

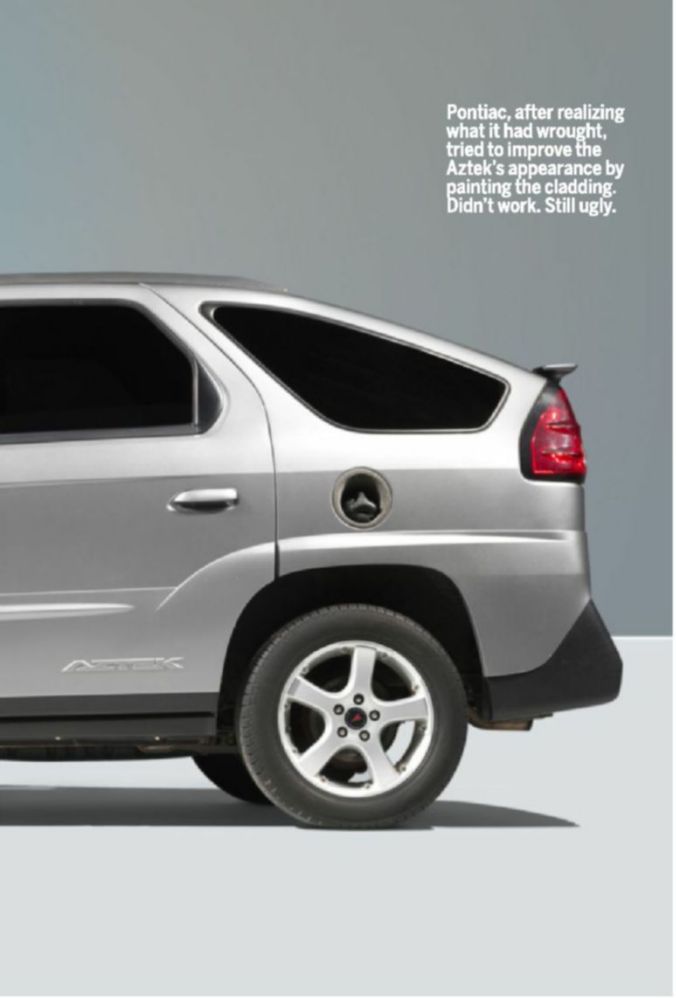
The Bear Claw idea was to lash the practicality and off-road capability of an SUV to the performance and excitement of a sports sedan. Instead, the production Aztek, powered by the corporate 3.4-liter V-6 and with a decidedly on-road–focused optional all-wheel-drive system, combined the performance, excitement, and

The Buick Rendezvous Proves That Ugly Is Relative

Next to its Aztek platform-mate, Buick's Rendezvous didn't look all that horrible. A mildly less repellent exterior and Tiger Woods's shilling helped the Buick crush the Pontiac in sales. It still sat on the hideous end of the design spectrum, but it survived until 2007, two years longer than the Aztek.

MOSH PIT IMAGES BY DANIEL LIPPITT/GETTY IMAGES

top photograph by JOHN ROE


Pontiac, after realizing what it had wrought, tried to improve the Aztek's appearance by painting the cladding. Didn't work. Still ugly.

off-road capability of a minivan with the lesser practicality of a chopped minivan.

Bob Lutz, who took over the top product job at GM in the aftermath of the Aztek, has claimed that the design was presented to focus groups who felt about the thing the way we all felt about it when we first saw it: They hated it. Well, actually Lutz claimed that the market-research respondents said, "I wouldn't take it as a gift." So convinced were the powers that be of the essential rightness of the vehicle, though, that this didn't kill the Aztek, either.

Instead, GM—stung by years of criticism that it was a stodgy old corporation that produced stodgy old designs—pushed ahead. This was an era in which the General produced a number of vehicles that were determined to be innovative, regardless of whether buyers were interested in such innovations. Remember the awkward GMC Envoy XUV with a power-retractable roof over the cargo area? That arrived only a few years after the Aztek, which itself was an idea of versatility rendered in plastic and corporate parts-bin pieces. One of the Aztek's few claims to cleverness was a removable insulated drink cooler mounted between the seats. That feature was later copied by zero car companies.

So poorly was the Aztek's styling received that General Motors announced it would restyle the thing after only five months on the market. That didn't help, either. Pontiac finally took the Aztek behind the barn in 2005.

And behind the barn it should stay. It's no more worthy of reassessment, ironic or otherwise, than is Limp Bizkit. It should live on only as a memory. And then only for use in cautionary tales.

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B

Backfires
See "Letters."

Bailout
See "Detroit."

Ball Joint
A flexible joint, consisting of a ball and socket, used primarily in front suspensions and your shoulders because it can accommodate a wide range of angular motion.

Banana
A design term used to describe the open space in a steering wheel between the top of the hub and the rim. Also Donkey Kong's weapon of choice.

Ford returned to Le Mans 50 years after its 1966 sweep in hopes of recapturing the glory with the new Ford GT. A Porsche 919 Hybrid won overall, but the GT (left) took the LMGTE Pro class, beating out a Ferrari 488 GTE.

Battle

Hell hath no fury like a Ford scorned.
by Preston Lerner

History sometimes makes it seem as though the events of the past were inevitable. Gazing at photos of Dan Gurney and A.J. Foyt spraying champagne after winning Le Mans in a Ford GT40 Mark IV in 1967, it's difficult to imagine any other result. Yet the Ferrari 330 P4s that finished second and third crushed the 11 other Ford GTs in the race, and the big-block beast driven by Foyt and Gurney was the only Ford to run trouble-free to the finish. So, in effect, Ferrari was only a silly mistake or a sheared bolt away from winning the great road-racing war of the 1960s.

Of course, Enzo Ferrari had nobody but himself to blame. Not for losing the war but for starting it in the first place. He'd set the saga in motion four years earlier, when he let it be known that he was interested in selling his company. Ford Motor Company proposed a corporate marriage, but after playing with Ford's affections and money, Ferrari jilted the Americans. An apoplectic Henry Ford II vowed revenge. "You go to Le Mans," he growled, "and beat his ass."

Ford commissioned the design and construction of a sleek mid-engined missile packing a potent pushrod V-8. It was dubbed the GT40 because it stood 40 inches high, and it was the fastest sports car the world had ever seen. Though not the most reliable. In 1964, its first season, the GT40 didn't finish a single European race. In 1965, it won finally at Daytona, but the rest of the season was a bust.

Ford found its groove after putting resident snake charmer Carroll Shelby in charge. Meanwhile, Ferrari was hamstrung by labor strikes and a crisis of confidence. In 1966, GT40s swept the American races at Daytona and Sebring, then descended on Le Mans with an armada of unprecedented size. Fords finished 1-2-3 and rubbed it in by trying to stage a dead-heat finish.

Ford's midcentury assault on Le Mans remains the high-water mark of American achievement in international motorsports. (The latter-day class victories by the Corvettes and the Ford GT seem puny in comparison.) Ford also established the template that automakers use to this day when they go racing—spend money on marketing and internal R&D but give operational control to pro race teams, such as Pratt & Miller.

A privately entered GT40 won Le Mans in 1968 and 1969, giving Ford four consecutive wins at the 24-hour classic. Ferrari never again finished better than second.

top photograph by GEOFFREY GODDARD

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The 2000, shown here in tii form, became not just the blueprint for future sports coupes and sedans but the segment's Platonic ideal.

BMW 2002

It was the birth of the sports sedan, and C/D was there. by Rich Ceppos

It started with "Turn Your Hymnals to 2002." That invocation, penned by the late David E. Davis Jr. in his paean to the 1968 BMW 2002 in our April 1968 issue, marked the beginning of the sports-sedan era. The 2002 wasn't the only car of the time that synthesized the agility of a European sports car and the practicality of a compact sedan, but we instantly recognized it as the best and heralded the news to our readers.

Back then, of course, no one could know that the 2002 would give rise to the enthusiast-oriented vehicles that flourish to this day. We certainly didn't know that the 2002 and the 3-series it begat would win 23 10Best awards. Or that the 2002's popularity would lead BMW to cultivate, own, and then walk slowly away from the Ultimate Driving Machine ethos. We only knew that it was a breakthrough—and that it was our job to tell car lovers about it.

Though the 2002 was as Germanic as sauerbraten, it actually had something in common with '60s American muscle cars: It followed the same big-engine-in-a-small-car formula. The difference was a matter of scale. The car that BMW started with, the 1600, was a diminutive, boxy two-door rear-driver that weighed 2010 pounds. It was powered by a spunky 96-hp 1.6-liter inline-four, and it could run about 100 mph flat-out on the autobahn.

To create the 2002—the name stands for "two-liter, two-door sedan"—BMW stuffed its 113-hp 2.0-liter inline-four under the 1600's clamshell hood. That was still a minuscule amount of power in 1968 America. But what the little Bimmer lacked in tire-smoking acceleration—it hit 60 mph in 9.6 seconds in *C/D* testing—it made up for elsewhere.

The 2002 educated a generation of enthusiasts about the sublime calculus of Teutonic ride and handling. Supple, long-travel suspension (independent at the rear), communicative manual steering, and grippy radial tires made it a revelation on two-lane roads. David E. wrote that he quickly learned "not to tangle with the kids in their big hot Mothers with the 500-hp engines, unless I can get them into a tight place demanding agility, brakes, and the raw courage that is built into the BMW driver's seat as a no-cost extra." The 2002 was priced right, too—about as much as a Chevy Impala—and beautifully assembled.

And when *C/D* anointed the 2002 as The One, enthusiasts responded. I know because I was one of them. Four years after our original 2002 story ran, I found myself behind the wheel of my own—the high-performance, 140-hp fuel-injected tii version—harassing sports cars such as Triumph TR3s, MGBs, and Alfa Spiders on the roads of Massachusetts. My 2002 was everything *C/D* said it would be and more.

At a time when four-cylinder engines sounded as if they were grinding meat, the 2002's overhead-cam four was sewing-machine smooth. My tii flowed over lumpy western Massachusetts two-lanes at speeds that would have bucked my old Pontiac GTO into the trees. Interstate blasts were a pleasure, tracking true at 90 mph with 25 mph in reserve. The German magazine *Auto Bild* reportedly nicknamed the 2002 the *Flüstern Bombe*, which meant whispering bomb, and it was easy to see why.

In those days, 2002 ownership granted you instant membership into an automotive cult of informed insiders who reveled in the car's autobahn-bred driving experience. We flashed our high-beams at one another. We shared our experiences at BMW Car Club of America meetings. Early 2002 adopters became the core of the growing BMW brand, singing the praises of their little rockets and encouraging others to give them a try.

The 2002's legacy is alive in the sports sedans that followed in its tracks, including the 17 current competitors to the BMW 3-series sedan and 4-series coupe, direct descendants of the 2002. Beyond that are all the hot hatchbacks, sedans, and even SUVs and crossovers inspired by the little BMW's breakthrough blueprint.

Back in 1968, though, there was nothing quite like the plain, slab-sided coupe with the heart of a sports car. The 2002 was the first of its kind.

Now if you will, please turn your hymnals, once again, to 2002.

1972 BMW 2002tii*

VEHICLE TYPE: front-engine, rear-wheel-drive, 4-passenger, 2-door coupe
PRICE AS TESTED: N/A
BASE PRICE: $4286
ENGINE TYPE: SOHC 8-valve inline-4, iron block and aluminum head, port fuel injection
DISPLACEMENT: 121 cu in, 1990 cc
POWER: 140 hp @ 5800 rpm†
TORQUE: 130 lb-ft @ 4500 rpm†
TRANSMISSION: 4-speed manual

DIMENSIONS
WHEELBASE: 98.4 in
LENGTH: 166.5 in
WIDTH: 62.6 in
HEIGHT: 55.5 in
TRUNK VOLUME: 10 cu ft
CURB WEIGHT: 2290 lb

Car and Driver Test Results

ZERO TO 60 MPH: 9.0 sec
1/4-MILE: 16.8 sec @ 81 mph
TOP SPEED: 115 mph (drag limited)
BRAKING, 80–0 MPH: 285 ft

FUEL ECONOMY
***C/D* OBSERVED:** 20–23 mpg

**Specs and results, February 1972.*

†*SAE gross.*

Shell V-Power NiTRO+ Premium Gasoline
The Official Fuel of CAR AND DRIVER

Boost
The increase above atmospheric pressure inside an engine's intake manifold created by a supercharger or a turbocharger. Also, a short-lived magazine about tuner cars.

Bore
That one guy in your office who won't shut up about what he's doing this weekend. Nobody cares, Glen. Also, the diameter of a cylinder—the round cavity in an engine block in which the pistons rise and fall.

Brake Torquing
A technique used on automatic-transmission–equipped vehicles to improve initial acceleration by holding the brake pedal with one's left foot while pressing the accelerator with the right, thus increasing engine rpm while keeping the vehicle stationary. Releasing the brake at the elevated rpm generally improves off-the-line acceleration.

Ceppos from the era when a man's hair and his wheels were nearly the same size.

photography by MARC URBANO

Bricklin, Malcolm

And a bunch of other idealists and entrepreneurs who tried to bring us the cars of their dreams. by John Pearley Huffman

Malcolm Bricklin, like the others on this list, dreamed of slaying giants. Some succeeded, some didn't, and some had a little too much Don Quixote in them for their own good. What each of them proved is how hard it is to build your own car. And so we celebrate their drive and ambition—even if one of them turned out to be a total con job.

Malcolm Bricklin (1939–)
General Vehicle (1971–1975)
Known for: Introducing Subaru and the Yugo [see "Y"] to the U.S. market. Created his own car, the gullwing-door Bricklin SV1. Now promoting the three-wheel electric Bricklin 3EV.
Cars produced: 2872

Alain Clénet (1944–)
Clénet Coachworks (1975–1982)
Known for: The neo-classic Clénet Series roadsters. Has since started and sold a company that builds adjustable bed bases.
Cars produced: 485

Gerald Wiegert (1945–)
Vector Motors, a.k.a. Vector Aeromotive, a.k.a. Avtech Motors, a.k.a. Vector Supercars (1971–present)
Known for: The Vector W8 supercar [see "V"].
Cars produced: 35 (est)

Earl "Madman" Muntz (1914–1987)
Muntz Car Company (1950–1954)
Known for: The Muntz Jet, a sporty V-8–powered luxury car. He was wisely moving into the cellular telephone business just before his death.
Cars produced: 394 (est)

Liz Carmichael (1937–2004)
a.k.a. Jerry Dean Michael
Twentieth Century Motor Car Corporation (1974–1978)
Known for: Gender bending and a three-wheel con job called the Dale. Convicted of grand theft, securities fraud, and conspiracy. Served two years.
Cars produced: 1 prototype

John Z. DeLorean (1925–2005)
DeLorean Motor Company (1975–1982)
Known for: The DMC-12 car and an infamous cocaine bust. One prosecution, no convictions.
Cars produced: 8583

Paul S. Moller (1936–)
Moller International (1983–present)
Known for: Developing the SuperTrapp muffler and working for six decades to bring the flying car to reality. Settled a dispute with the U.S. Securities and Exchange Commission in 2003.
Cars produced: A few prototypes

Preston Tucker (1903–1956)
Tucker Corporation (1944–1948)
Known for: The rear-engine Tucker 48 sedan. Indicted for securities fraud. Found not guilty.
Cars produced: 51

Steve Saleen (1947–)
Saleen, Inc. (1984–2007), SMS Signature Cars (2007–2011), Saleen Automotive (2011–present)
Known for: Highly modified Mustangs that bear his name. Currently running his revivified eponymous tuner-car company.
Cars produced: 15,571 (est)

Bushing, Suspension A simple bearing that reduces friction and allows for limited rotary motion; typically made of rubber, polyurethane, or other ic. A bushing's compliance can have a great effect on ride and handling.

BUSHING ILLUSTRATION BY PETE SUCHESKI

illustrations by VIN GANAPATHY

DO YOU STEER CLEAR OF BAD CAR ADVICE?

MAGAZINE MEDIA

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#BelieveMagMedia | BelieveMagMedia.com

Sources: Simmons Research, Multi-Media Engagement Study, Spring 2016; GfK MRI, Spring 2016.

CAFE
CORPORATE AVERAGE FUEL ECONOMY.

by Csaba Csere

Enacted by Congress in 1975, the Corporate Average Fuel Economy law was designed to reduce gasoline use by improving fuel efficiency. Starting in 1978, cars had to achieve 18.0 mpg in testing. Truck standards came a year later, requiring 17.2 mpg from two-wheel-drive vehicles and 15.8 mpg from four-wheel-drivers. The current regulation would raise these targets to 55.3–56.2 mpg for cars and 39.3–40.3 for trucks by 2025, although the Trump administration is reviewing that plan.

Slow Build: The CAFE bogey was intended to rise steadily, but it hit 27.5 mpg for cars in 1985 and essentially remained there for 25 years. Trucks stagnated around 20 mpg for 20 years.

Optimism Meets Reality: Congress required each new car's mileage to be posted on its window sticker, hoping that buyers would select more efficient vehicles. But the lab-measured results were way higher than anyone was getting in the real world. In the '80s, mileage numbers on the label were trimmed in an attempt to bring them closer to reality, but even that wasn't enough. In 2008, the EPA revised fuel-economy testing to improve label-number accuracy. For example, a 1984 Cadillac Seville diesel was said to achieve 22 mpg city and 36 highway in period. Apply the '08 adjustment and those numbers fall to 18 and 26 mpg.

Size Matters: Originally, every company's CAFE target was the same. In 1980, this was great for small-car importers but not so good for Detroit iron. Starting with 2011 models, mileage requirements were determined by a vehicle's "footprint," basically a vehicle's average track width times its wheelbase. Bigger vehicles have a lower mileage target, and each manufacturer's CAFE requirement is based on the vehicle mix it sells.

A Bridge Too Far: When President Obama announced in 2011 that the industry fleet standard would rise to 54.5 mpg by 2025, it was DOA. That widely touted target assumes buyers will purchase more cars and fewer trucks in 2025 compared with today. In fact, the market is moving in the other direction. Even if the 54.5-mpg bogey were implemented, that number is based on the highly inflated CAFE test numbers of 1978. Translated into today's label numbers, a 54.5-mpg vehicle would have a window sticker with 38 mpg city and 55 mpg highway.

Cannonball

by John Pearley Huffman

Catalytic Converter
An exhaust-mounted component that drives chemical reactions among the exhaust gases to reduce environmentally unfriendly emissions. The catalytic material is typically made from a combination of precious metals such as platinum, rhodium, and palladium.

Coast-Down Test
Performed on a flat surface and ideally in wind-free conditions, this test determines the sum of all driveline friction, tire rolling resistance, and aero drag working against a vehicle in motion. The vehicle is timed as it coasts in neutral from a set speed to zero mph. The findings are used to conduct laboratory fuel-economy tests.

Comparison Test
Ranking cars leads to rancor, but someone's got to do it [see "Hatches, Hot"].

Concept Cars

by Jens Meiners

The first concept car, the Buick Y-Job, was a 1938 Motorama confection and therefore ineligible for our 1955-to-present encyclopedia. Instead, we offer you two key postwar concepts from the classic and modern eras.

Alfa Romeo Carabo: Unveiled at the Paris auto show in '68, the Carabo was a one-off by design house Bertone, penned by the great Marcello Gandini, the creative force behind the Lamborghini Miura and Countach. The Carabo ushered in the wedge era of automotive styling, a futuristic and angular aesthetic that left a lasting impression on scissor-doored supercars but also trickled down to the mainstream. Up until the "organic" and retro designs of the 1990s, there was a bit of Carabo in nearly every new car.

Vision Mercedes-Maybach 6 Cabriolet: Launched during the Pebble Beach Concours d'Elegance in August, this huge convertible is hardly a vision of a commuter car. But it foretells Mercedes' future styling language, serves as a preview for a new Maybach grille that will migrate to the super-luxury brand's cars this spring, and underscores a commitment to electrification. But perhaps its most important role is that it's an automobile worth dreaming about. Hence, a real concept car.

Corvair SCANDAL The Corvair's rear-mounted air-cooled flat-six made it something of a blue-collar Porsche 911, but a rear weight bias, a swing-axle rear suspension, and largely ignored tire-pressure settings gave early versions a tendency to drift at inopportune times. Chevy had already moved the car to a more advanced independent suspension by the time Ralph Nader [see "N"] published *Unsafe at Any Speed*, which cast the Corvair as a fizzing grenade and turned it into the poster car for an irresponsible industry. Sales collapsed by 1966, though the car remained on the market for three more years.

In 1971, eight cars and 23 people competed in the inaugural Cannonball Baker Dash. Yates and Gurney's Ferrari won the 2876-mile race in 35 hours and 54 minutes.

In the early '70s, this magazine's Brock Yates sensed a ripple in the American collective consciousness and decided to ride it across the country with his Cannonball Baker Sea-to-Shining-Sea Memorial Trophy Dash. So compelling was this transcontinental road race that its high degree of illegality didn't matter much. The result permanently warped our culture.

After Yates allowed the Cannonball Baker to end in 1979, imitators were inevitable. How do they stack up? Using our arbitrary rating system of 100 points, where the original scores a 100, everything else pales in comparison.

○ - NO ● - YES

	Legal?	Clandestine?	A Race?	Rules?	A Parade?	Stages?	Brock Yates?	Dan Gurney?	Inspirational?	Branded Merchandise?	Cheap to Enter?	Swanky?	American?	Restricted?	Record-Setting?	Made for TV?	Total Coolness
Cannonball Baker Sea-to-Shining-Sea Memorial Trophy Dash 1971–1979 (five races)	○	●	●	○	○	○	●	●	●	○	●	○	●	○	●	○	100
U.S. Express 1980–1983 (four races)	○	●	●	○	○	○	○	○	○	○	●	○	●	○	●	○	70
The 2904 2007–present (seven races)	○	●	●	●	○	○	○	○	○	●	●	●	●	●	●	○	68
C2C Express 2016–present (one race)	○	●	●	●	○	○	○	○	○	○	●	○	●	○	●	○	67
Cannonball Run 2001: Race Across America 2001 (one pretend race)	●	○	○	●	○	●	●	○	○	●	●	○	●	●	○	●	12
The Bullrun Rally 2004–2014 (11 rallies)	●	○	○	●	●	●	○	○	○	○	○	●	●	●	○	●	11
Gumball 3000 1999–present (19 rallies)	●	○	○	●	●	●	○	○	●	●	○	●	○	●	○	●	10
Cannonball Run 2016–present (two rallies)	●	○	○	●	●	●	○	○	○	●	○	●	●	●	○	○	10

Corvette

ZR1

To make a Corvette even mightier than the Z06, you need only two things: power and downforce.
by Jared Gall

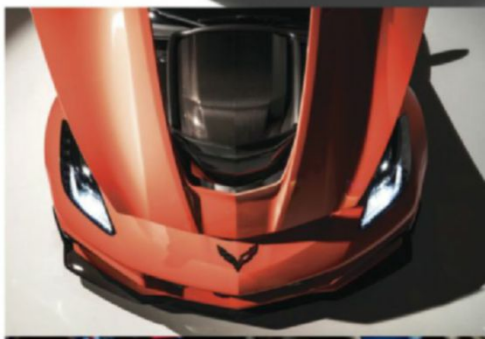
_photography by John Roe

2019 Chevrolet Corvette ZR1

There's no pretending anymore that a tectonic shift isn't on its horizon, but the Chevrolet Corvette as we know it is still evolving as if it's in a time-lapse video. In 2013, the Z06 was a 505-hp middle manager toiling in the shadow of the supercharged ZR1; just a generation later, it outearns its former boss with a 650-hp blown LT4, establishing itself as the greatest performance value of all time. At Virginia International Raceway for our annual Lightning Lap track extravaganza, the current-generation Z06 fell short of an $875,000 limited-production hypercar by only a second and a half—at a savings of some three-quarters of a million bucks. It'd be pretty easy to make a Z06 faster with another $775,000.

Or you could let Chevy do it for you at a significant discount. Final pricing for the 2019 ZR1 isn't settled, but expect it to track the C6 generation and start just above $120,000. It's not wrong to think of the ZR1 as a Z06 with more. Both have supercharged engines, and aside from that, their drivetrains—either the seven-speed manual or the eight-speed automatic—are the same right down to the gear ratios. Suspension differences are limited to tuning. There are no fancy spool-valve shocks here, as there are on a Camaro ZL1 1LE; as with the Z06, the ZR1 uses magnetorheological dampers. The ZR1's front wheels are a half inch wider, changing the tire's shoulder geometry, but its standard and optional rubber are the same pieces Z06 buyers get, and the ZR1's brakes are the Z06's optional rotors and calipers with new pads.

But the ZR1 is precisely one step beyond just "more." Longtime Corvette chief engineer Tadge Juechter describes the ZR1 as "the most we know how to do." Here, the most means

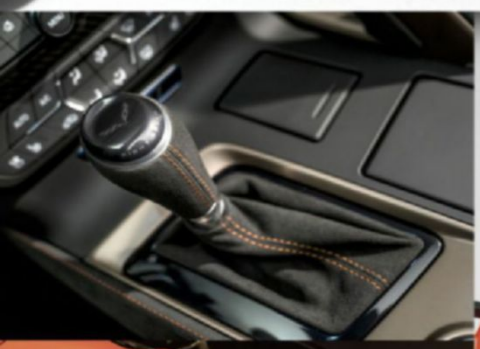


about 750 horsepower and 680 pound-feet of torque. And it starts, as it did in 1990 on the first ZR-1 that most people remember, with an engine called LT5. With pushrods instead of its ancestor's dual overhead cams, though, this LT5 is an evolution of the 6.2-liter LT4 powering the current Z06. Like the Z06's engine, this one is capped by an Eaton supercharger. The blower is bigger than the LT4's, pumping 52 percent more air with each revolution, and taller by 2.9 inches. Corvette exterior design manager Kirk Bennion says that, when the design team tried to maintain typical hood clearances, "you got behind the wheel, and you couldn't even see the right side of the car." Faced with this difficulty, his team decided to stay home.

Stay home from Europe, that is. Forgoing European sales and ignoring the Continent's rule book meant not having to meet its stringent pedestrian-protection regulations. In Europe, the head of anybody who steps in front of a moving car is entitled to smash through a minimum amount of (relatively) soft material and space before contacting hard engine parts such as intake manifolds, superchargers, or intercooler bricks. Here in the U.S.A., we have thicker skulls—perhaps related to an above-global-average dairy intake—and our regulators will let you bonk your noggin on an engine that sticks up through the hood. The largest chunk of that carbon-fiber strip running down the center of the ZR1's nose is, in fact, the intercooler cover. As Juechter describes it: "You've got no air gap between the engine and the hood, you've got no hood blanket, you've got no construction between the hood inner and outer. All that stuff usually stacks on top [of the engine], but we consumed all of that and then let the engine crawl out another inch, inch and a half." Adds Bennion: "It was a challenge to get that hood right. It could get real backwoods on you real fast."

While you can now see the right side of the car, the view from the driver's seat is still plenty dramatic: Luke Skywalker's as he zooms down the trench toward the Death Star's exhaust port. And, Juechter promises, it's even more dramatic when you start the car. "[The engine]

Above: We used to fit wings like this on our Lego creations, which also had sweet lasers. Below: An engine so monstrous that no hood can contain it.



moves around on you. You step on it, you can see the engine trying to pick the front of the car up and come out of the hole. Every twitch of your foot, you can see how the driveline is moving. It's part of the charm." In much the same way a great white chomping on the bars of your dive cage is part of the charm. We're also told the LT5 will shoot flames from its exhaust, so there's even charm for the people behind a ZR1.

That last bit is a conveniently badass byproduct of the engine's new fuel-delivery system, which uses both port and direct injection. At the other end of the combustion cycle, there's another benefit to Corvexit: louder exhaust. U.S. pass-by noise regulations allow more decibels than do the EU's. In addition to the electronically controlled butterfly valves in a Z06, the ZR1's exhaust system incorporates a newly patented internal valve that Juechter likens to the flap on top of a semitractor's exhaust pipe. A spring holds it closed under light loads, but as exhaust flow grows more urgent, it overcomes the spring pressure and pushes the valve open, allowing for a smoother rise to the volume than the all-or-nothing character of the butterfly valve alone.

Beyond the larger supercharger and the fuel-injection system, the biggest differences between the LT4 and LT5 are the latter's larger throttle body and strengthened crankshaft. Even with the computer dialing back the torque output in the lower gears, Chevy figures the ZR1 will hit 60 mph in less than three seconds, clear the quarter in less than 11, and top out beyond 210 mph. Juechter says: "Some companies, when they go up in horsepower, what they're really doing is just extending the torque curve . . . the peak torque isn't higher at all, it just extends a little bit. We've elevated the torque across the range. It feels stronger than a Z06 all the way through the gear run-up, not just a little extension at the end."

We can confirm that while in the driver's seat, it is possible to see over the engine . . . mostly. Hope you like the familiar Corvette interior.

"If you're going to engage in an endeavor like this," adds Tom Peters, "you need that noticeable transition or contrast. You know a customer is going to expect it." As design director for performance cars at GM, Peters shouldered much of the responsibility for the other half of the ZR1's story: aerodynamics. Aside from the rear wing and different wheels, the Z06 and ZR1 are identical aft of the A-pillars. Forward of them, no bodywork is shared, and engineers crammed an additional four heat exchangers into the nose. Each outboard nostril contains a new radiator and intercooler. The two intercooler bricks underhood are enlarged to twice the size of the

LT4's. The ZR1's larger blower and additional coolers add some 140 pounds to the Z06's curb weight, most of it concentrated in the nose. A chief collaborator on the ZR1's styling was air. Maximizing airflow through all those exchangers meant extensive wind-tunnel development, using both scale models and full-size cars in a rolling-road wind tunnel. "We see aerodynamics as an opportunity to make the car more unique, more pure and genuine," Peters says. "To me, that's universal truth, and that's design."

Not all ZR1s will wear as extreme an aero package as the car on these pages. This one is fitted with the ZTK performance package, which includes Michelin Pilot Sport Cup 2 rubber, specific tuning of the magnetorheological dampers, and that mondo rear wing. A smaller one is standard. The ZTK wing offers 10 degrees of adjustability and generates some 500 pounds of downforce at top speed. That's more than the Z06's wicker bill generates, and it's a vastly more efficient way of making downforce, which explains how the ZR1 can tack another 25 or so mph onto the Z06's top speed.

"You see a lot of poseurs out there who just bolt the wing to the hatch, so it goes up with the hatch," Juechter notes. "But if you're generating true downforce, like epic quantities of downforce, you can't route that through the hatch. You'll crack it." So his wing mounts aft of the hatch opening, where two aluminum castings tucked inside the fascia tie into the back of the car's composite tub and transmit that load down to the bumper beam. He demonstrates the sturdiness of the setup by yanking on the wing with both hands, which shakes the whole car.

ZR1s without the performance package will have the same carbon-fiber front splitter as the car on these pages, but the ZTK adds spindly vertical end plates that owe their toe-lopping thinness to the decision to stay out of Europe. According to Juechter, the EU's pedestrian-protection rules mandate "very doughy radii" on such pieces. Why two different aero packages on such a low-volume model? "We wanted to have the aerodynamic performance for our top-level track car," he explains, "but we also wanted to have a car that people could drive to the country club and put their golf clubs in the back." Or, for that matter, stow the roof panel. That big wing is going to complicate loading and unloading.

The ZR1 might be the ultimate track Corvette, but its creators don't see it as being the craziest. That title still belongs to the Z06. Their goal with the ZR1, Juechter says, is "to have the performance accessible, to have people who are not necessarily professional drivers be able to get into and experience a 750-hp car and be able to get close to its limits and feel comfortable doing it." To that end, the springs, dampers, and electronically controlled limited-slip differential are all calibrated for forgiveness. Unlike the positively brutal Camaro ZL1 1LE, the ZR1 is a "have your cake and eat it, too" kind of car, according to Juechter—a high-powered grand tourer. It will still be faster than the Z06, of course. Chevy's team uses a different track configuration than we do for Lightning Lap but says the ZR1 laps VIR 2.5 seconds quicker than a Z06. If we can replicate that performance on the longer Grand West Course, the ZR1 should set a new Lightning Lap record.

It seems Chevy is gunning for a sales record with this ZR1 as well. We've seen spy photos of ZR1 convertibles in addition to the coupes, so it appears that this generation will be available in all the flavors of the regular Corvette lineup. Regardless of transmission or body style, the ZR1 promises to run away from more expensive machinery on a racetrack for a fraction of the price. No matter how much the Corvette might change, that's one thing that never will.

Handsome ZR1-specific wheels cover Z06 brakes. Pedestrian-leg-slicing carbon-fiber end plates come with the ZTK package.

Dating

by Faye Brennan, deputy editor of Cosmopolitan

I've never dated a guy with a nice car. My first boyfriend drove an old, unexceptional Nissan Altima. It was all he could afford on his bartender salary. And my last few boyfriends didn't even own cars (as is often the case in Manhattan). It's my hope that, like me, no woman in our increasingly enlightened society would be so materialistic as to judge a guy by the type of wheels he owns—or lack thereof. That just seems so . . . '80s.

However, I would be lying to you if I said that a nice car doesn't still have some sliver of influence on how we perceive a man's attractiveness . Of course it does. Cars have been synonymous with masculinity, sex appeal, and status since the electric starter dignified vehicle ownership. But to me, it all really hinges on the condition of your ride. If you roll up to a date in a shiny, pristine, dent-free car, it proves you can take care of something and respect its value. That will always be hot. Show up in a barely puttering rusty POS? Yeah, any girl is going to assume you're a lazy douche canoe.

Something else that will never change: Women will always take into account how we feel when sitting in a guy's passenger seat on a date. The sportier the car, the closer we're required to sit next to you (and do we like that?). The better the audio system, the quieter our nerves become. And the darker the tinted windows, the further we'll consider going with you in the back seat. This is why parents will continue to fear the day their daughters start riding in cars with boys—they know exactly what that can lead to, because they've experienced the anticipation and thrill of it themselves.

So, really, guys, I'm not telling you anything you don't already know. Ever since you were a horny, testosterone-fueled teenager getting behind the wheel of a 4000-pound machine for the very first time, you've recognized what a weapon of seduction a car can be. And you probably did every stupid thing you could to use it to its full advantage—like attempting a 90-degree turn at 70 mph to impress your high school crush, only to come within inches of crashing into a stone wall (I'll never let you live that down, Brian). Or maybe you did so many donuts in the parking lot of Chili's that you completely blew your power steering (but at least my friends and I were watching, right, Shenorock boys?).

In other words, so long as the instinctive—and ridiculous—mating rituals of males and females persist, cars will always have a supporting role in our romantic lives. Knowing this, I'm actually kind of jealous of the generation that gets first dibs on driverless cars. Just imagine how wild things may get in one of those.

→

Death

Unpadded metal surfaces, blunt knobs and rods, steering columns that impale—and seatbelts weren't even on the options list. We may think highly of the 1955 Chevrolet, but like all cars of the era, it didn't think much of its passengers.

Yes, 62 years later, things have become much safer. by John Pearley Huffman

A-Pillars: The '55's wraparound windshield was gorgeous. It also left the front of the roof supported by only thin pillars of sheetmetal, ready to collapse under the car's weight in a rollover. But just look at them.

Steering Column: Though the collapsible steering column was invented in the 1930s, GM didn't begin installing them until 1967.

Steering-Wheel Hub: A bullet-nose cap at the center of Chevy's two- and three-spoke steering wheels all but guaranteed forehead-shattering or sternum-smashing injuries.

Dash: No squishy soft surfaces here. Only paint cushioned the blow from skull-crushing metal.

Hood Ornament: A glorious homage to jet-age styling with sharp edges that filleted pedestrians as they were launched skyward.

Parking-Brake Lever: An unforgiving steel tube filled with an unforgiving steel rod. In other words, the sword of Damocles.

Door Latches: If they didn't pop open in a crash, they stayed closed, jammed by a collapsed structure.

Doors: No built-in guard beams, no soft surfaces, and with handles and window cranks seemingly designed to gouge flesh. Combine these doors with a structure that buckled, and you end up with an animal trap. That we survived at all is amazing.

Front Crumple Zone: In a crash, the frame and passenger compartment would buckle and metal would fold onto itself, but there was no managed energy absorption. If a gruesome injury didn't get you, you'd be trapped inside when the doors couldn't be opened.

Front Bench Seat: Held in with a couple of bolts, and without belts to hold humans in during a collision, the front seats did nothing to stop a body from bouncing around the cockpit like a pinball.

Fuel Door: Located on the driver's-side rear fender near the tail, where a collision virtually guaranteed a fuel spill. In '56, it was moved behind the taillight, which was worse.

illustration by CLINT FORD

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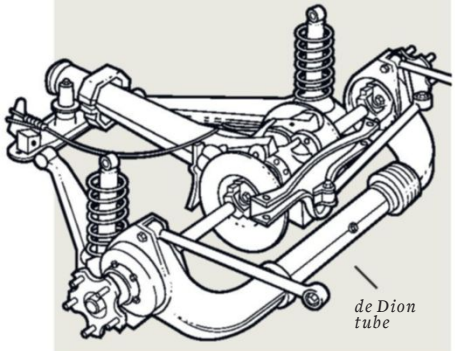
de Dion Suspension
A suspension design that uses a rigid element (de Dion tube) to connect the wheels and keep them parallel. It differs from a live axle by mounting the differential to the body and sending power to the wheels via half-shafts. Largely relegated to history's dustbin and the Smart Fortwo.



Detroit

by Paul Ingrassia, Pulitzer Prize-winning journalist and editor at the automotive research center the Revs Institute

The 20th century dominance of American car companies, thanks to corporate oligopoly and labor monopoly, started eroding with the Japanese invasion of the 1970s and 1980s. In this century, they have careened from vestigial dominance to historic bankruptcy (Ford alone escaped) to remarkable recovery and—recently—to frustration and humiliation at the hands of a Silicon Valley upstart [see "Tesla"]. For much of 2017, investors valued Tesla higher than General Motors, Ford, and Fiat Chrysler Automobiles even though, in 2016, GM sold more cars every three days than Tesla sold all year.

This roller-coaster ride isn't over. The industry is going through four simultaneous revolutions: propulsion, connectivity, automation, and community (meaning ride services like Uber). The four portend an era of continuous change, even if people don't forgo car ownership en masse. Many people already have the same emotional bond with cars as they now have with their Whirlpool washers. And the "move that metal" business model of the Big Three (and their global competitors) is likely to be upended.

The revolutions are already reverberating. GM and Ford have invested billions in "mobility services" and driverless-car development. Even advanced design is starting to be affected. "When you design the interior of a car, you start with the driver," Ford designer Christopher Svensson told a Revs Institute panel at the 2017 Pebble Beach Concours d'Elegance held in August. "But we need a different approach if there will be no driver." Design teams, he added, need new concepts.

The issue for Detroit—and for all established automakers—is how to balance investments in the future with profits for the present. Electric vehicles, computer-driven cars, and ride-sharing collaborations won't produce big profits for years. But companies that neglect them risk becoming automotive anachronisms. In this high-risk environment, the Detroit Three are driving in different directions.

Under Mary Barra, the first female CEO of a global car company, General Motors has divested chunks of its existing business to free funds for the future. GM recently sold its European subsidiary, Opel, to Peugeot and has largely exited Russia, India, and South Africa.

GM has invested in Lyft, the main ride-hailing rival to Uber, bought Silicon Valley startup Cruise Automation, and, just in October, revealed it would accelerate development of electric and driverless cars, much to the delight of Wall Street. GM has also launched its own hourly car-rental service, Maven, and has beaten Tesla to the mid-priced electric-car segment with its Chevy Bolt, though its roughly 2500 sales per month pale in comparison with the more than half a million Model 3 reservations Tesla is scrambling to fill.

Ford, meanwhile, has stretched—perhaps too far—to keep the company's global reach. Profits are down and its shares have plunged some 31 percent since mid-2014, when Mark Fields succeeded Alan Mulally as CEO. Fields got sacked this past spring.

Under Fields, Ford declared it would mass-produce a computer-driven vehicle by 2021 (which Silicon Valley experts derided as "product development by press release"). And Ford has been slow to fill big product gaps: Its EcoSport tiny SUV and Ranger small pickup truck haven't hit dealers yet.

New CEO Jim Hackett, who had previously led Ford's Smart Mobility division, must fill the gaps while assessing investments in driverless vehicles, the company's on-demand commuter ride-sharing service called Chariot, and more.

Fiat Chrysler—parent of Detroit's Chrysler—is taking a different tack: retreat. Not just from future-car tech but from the auto business altogether. CEO Sergio Marchionne is trying to sell the company because the controlling Agnelli family wants out of the high-stakes, high-risk automotive game (except for Ferrari, which has a separate corporate structure).

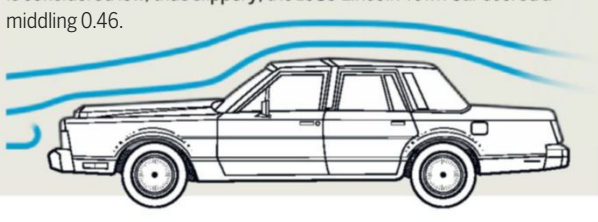
Rival automakers probably want only Jeep [see "J"] and Ram, but selling the whole company, as Fiat Chrysler prefers, likely requires a Chinese buyer. Great Wall Motors, which makes a pickup called the Wingle 5 (really), says it might be interested.

Meanwhile, electric-car specialist Tesla sports a market capitalization (as of press time) of $59 billion—below GM ($64 billion) but far ahead of Ford ($49 billion) and Fiat Chrysler ($27 billion). That's despite selling just 76,230 cars last year compared with GM's 10 million. And Tesla loses money, unlike the Detroit Three.

Tesla rankles Detroit execs. Its lofty valuation might not be fair or wise on the part of investors. But markets move on hope and hype as well as results, and Detroit is selling steak with little sizzle.

Except for one Detroit player, that is. Last May, Delphi Automotive, formerly a parts division of GM and itself a bankruptcy survivor, announced a daring split into two companies: its traditional powertrain components business and its new-tech line of systems for driverless cars. Over the next five months, pending the spinoff, Delphi's shares surged 30 percent, while the S&P 500 stock index rose less than 7 percent. Someone in Detroit, it seems, gets the Silicon Valley valuation game.

Drag Coefficient A unitless measure of the aerodynamic "slipperiness" of an object, commonly abbreviated as "Cd." A Cd near 0.30 is considered low, thus slippery; the 1989 Lincoln Town Car scored a middling 0.46.



INSET ILLUSTRATIONS BY PETE SUCHESKI

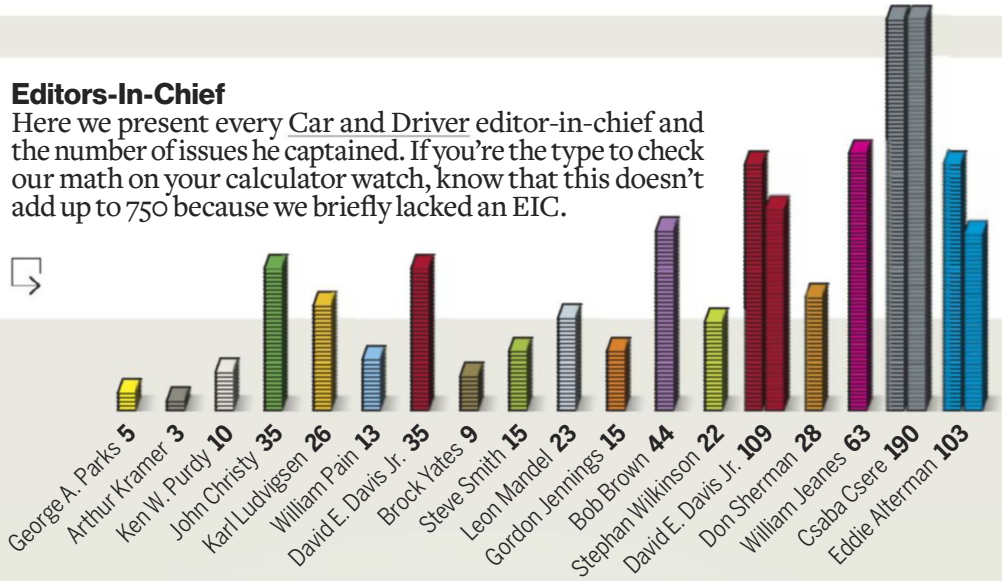
illustration by EDDIE GUY

DETROIT

Electric
See "Hybrids" and "Tesla."

Editors-In-Chief

Here we present every Car and Driver editor-in-chief and the number of issues he captained. If you're the type to check our math on your calculator watch, know that this doesn't add up to 750 because we briefly lacked an EIC.



Environment

If you're a fan of breathing, you'll want to thank these devices.
by K.C. Colwell

Automobile emissions are regulated in the U.S. by the Environmental Protection Agency on the national level, though states can elect to follow an even more stringent set of rules enacted by the California Air Resources Board. In fact, enough states have adopted these standards that the EPA is collaborating with CARB on its vehicle emissions rules for the 2022–2025 model years. Although cars aren't the biggest polluters, cleaning up their emissions has paid dividends in the air quality of places like Los Angeles. Here are some of the devices that help keep California's San Bernardino Mountains visible from the L.A. basin and the air we all breathe clean.

Exhaust Gas Recirculation: EGR redirects a portion of an engine's inert exhaust gas back into the intake tract to dilute the fresh air that's fed to the cylinders. This reduces the combustion temperature and the production of nitrogen oxides (NO_X). The amount of exhaust sent back into the engine is regulated by either an electronically controlled or vacuum-actuated valve. Diesel engines often water-cool the recirculated gases to increase the mass and the effect of the recycled gas.

Catalytic Converter: This exhaust component reduces engine emissions by passing the exhaust through catalytic material made of a combination of platinum, rhodium, and palladium. Once heated up by the exhaust, the catalytic material sparks a chemical reaction that changes carbon monoxide and hydrocarbons into carbon dioxide and water. Since 1975, nearly every car has been fitted with a catalytic converter.

Evaporative Emissions Control: Gasoline and diesel evaporate in a car's fuel system, releasing harmful hydrocarbon gases into the atmosphere. To combat this, all modern fuel systems are fitted with a charcoal canister that traps the evaporated fuel and stores it until it can be burned in the engine.

Diesel Particulate Filter: This works a bit like a paper air filter in that it traps particulate matter (i.e. the black soot that diesel engines can produce). Unlike a paper filter, a particulate filter isn't disposable. Instead, when the filter reaches a full state, the engine injects extra fuel after combustion to increase the exhaust temperature and burn off the trapped particulates (mostly carbon), resulting in the production of carbon dioxide and water.

Selective Catalytic Reduction: Like the catalytic converter, an SCR catalyst contains precious metals to drive exhaust-cleaning chemical reactions in diesels. Unlike a conventional cat, the SCR process requires an injection of urea into the exhaust to convert NOx into water, carbon dioxide, and nitrogen. Volkswagen famously cheaped out and didn't fit an SCR system in some versions of its diesel models, instead relying on cheaty software to pass federal emissions tests [see "Lab Results"].

photography by ROY RITCHIE

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Freedom

Remembering the liberating power of a Sunday drive. by John Phillips

In the late '50s and early '60s, my father mandated a weekly Sunday ride, deploying our 18-window Volkswagen bus or our split-window VW Beetle or one of his massive black Cadillacs with bumperettes like chrome bosoms. I sat beside my sister, Angie, who told me not to touch her. The Sunday ride lasted from one to four hours, and there were three understandings: 1) There'd be no stated destination; 2) We'd eat ice cream from Isaly's Dairy, whose swarm of black flies was matched only by an outdoor Jakarta market's; and 3) We'd buy a peach pie from the Amish in Plain City, Ohio.

There was no traffic apart from the horse-drawn buggies, whose occupants glared at us. On every ride, it was my father's habit to stop the car abruptly in front of a desolate cornfield. Without speaking, he'd dash to the berm and raise his hands to conduct a song—Angie and I comprised the choir—called "George Washington Bridge," which he had composed in Germany (also in the VW bus) and whose lyrics included these words only: George, Washington, and bridge. I still sing it in times of stress.

Our lengthiest rides were summer soirees, sans A/C, when I had no academics to beleaguer my conscience. My lone obligation was to play left field for my Little League team, Army, whose coach bribed us with two-dollar bills. My mind was otherwise an immature void, save schemes of chaotic me-centered recreation and daydreams of our annual father-son October trip to the Formula 1 race at Watkins Glen. Those rides and the United States Grand Prix represented a kind of automotive freedom I've rarely sampled since. And what I now realize is that our family cars were rarely worth more than $2500 and I never held a steering wheel for even one sweaty second.

Factory
See "Assembly Line" and "Marysville, Ohio."

Fish Carburetor
A carburetor that promised modest efficiency gains but became a legend when those gains were exaggerated. Conspiracy fans latched on and spread that this miracle carb had been squashed by Big Oil and car companies.

Five-to-60
A test that attempts to produce real-world acceleration numbers by eliminating an aggressive launch. The tester allows the vehicle to roll at a steady 5 mph and then floors the accelerator, recording the time it takes to reach 60 mph. The test can expose turbo lag and often favors vehicles with output low in the rev range.

Flip-Over SCANDAL The first Ford Explorer was a simple truck-based SUV sold to a public with a limited understanding of vehicle dynamics. But when Explorers started rolling over in crashes, drivers were vindicated by the discovery that the Explorer's Firestone tires were coming apart at the tread. Ford and Firestone kept passing the blame, making increasingly lurid accusations of each other's incompetence. Ultimately, it cost Bridgestone/Firestone around $1.7 billion and halved the value of the company; Ford had to pay approximately $590 million in damages and recall costs.

FLIP-OVER ILLUSTRATION BY T.M. DETWILER

top illustration by VIN GANAPATHY

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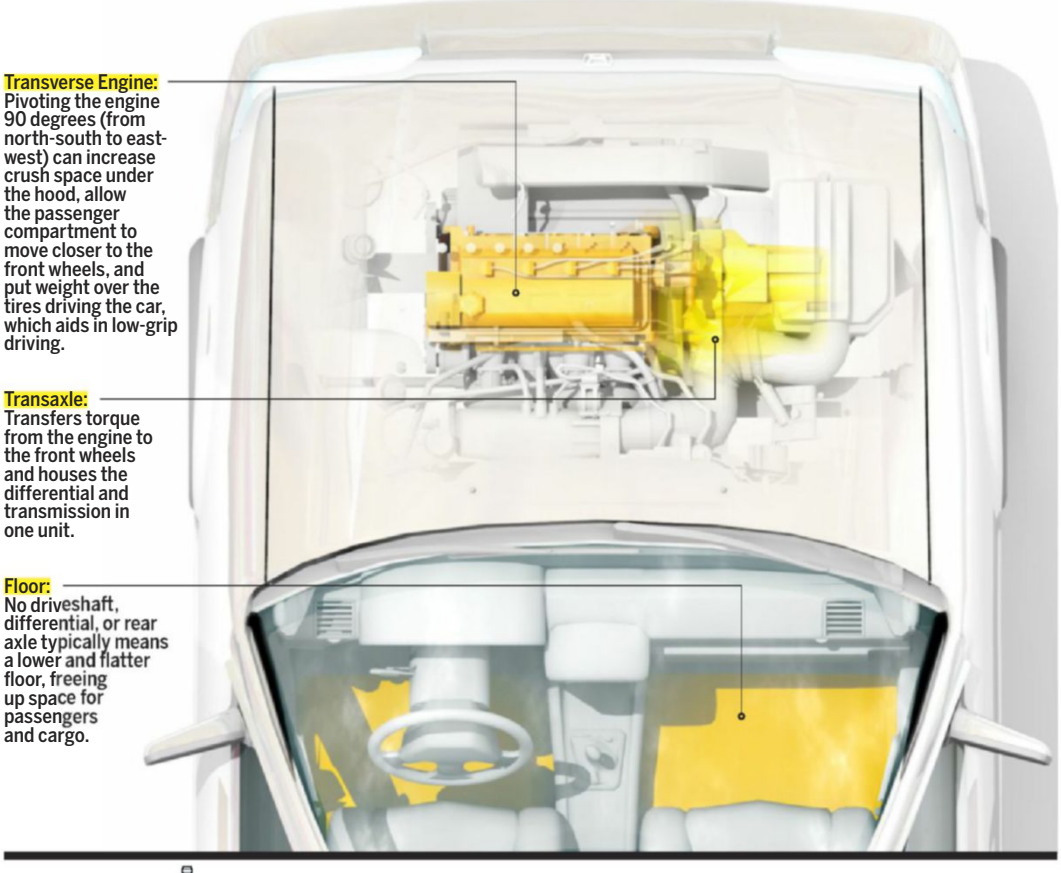
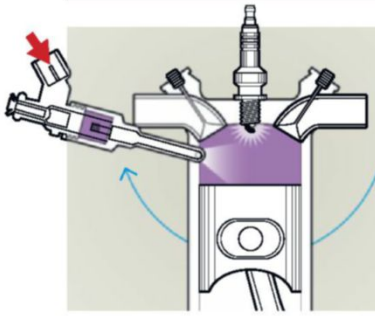
Front-Wheel Drive

The case for sending power to the fore. by Josh Jacquot

If engineers had had their way, front-wheel drive would have dominated automotive design from the beginning. But, in a victory for right-brain thinkers, stylists and enthusiasts actually have a say in the car-development process. Few can deny, though, that eliminating the large, heavy, costly, and inefficient rotating parts driving the rear wheels comes with numerous benefits. Namely, it frees up interior seating and cargo room and, in the case of transverse engines, provides more crush space between the front of the car and its occupants. And without a long driveshaft, rear axle (or axles), or rear differential, the car carries less mass; this, coupled with reduced driveline loss, aids efficiency. Also, front-drive construction puts the heaviest components of the machine over the tires driving it, increasing traction on slippery surfaces.

Despite its many advantages, however, front-wheel drive didn't truly gain traction (yes, we did that) until Congress enacted the Energy Policy and Conservation Act of 1975, putting in place the first CAFE [see "C"] standards. Smaller four-cylinder engines were not only more fuel efficient, they were also compact enough to be easily turned sideways, coupled to a transaxle, and made to drive the front wheels, laying the groundwork for the space-efficient packaging that dominates today's automotive landscape.


Transverse Engine:
Pivoting the engine 90 degrees (from north-south to east-west) can increase crush space under the hood, allow the passenger compartment to move closer to the front wheels, and put weight over the tires driving the car, which aids in low-grip driving.
Transaxle:
Transfers torque from the engine to the front wheels and houses the differential and transmission in one unit.
Floor:
No driveshaft, differential, or rear axle typically means a lower and flatter floor, freeing up space for passengers and cargo.



Fuel Injection A system that controls the amount of fuel delivered to an engine by mechanical or electronic means using pumps and injectors. Direct injection refers to a system that places the injectors inside the combustion chambers; port injection puts an injector in each cylinder's intake port; and the now defunct throttle-body injection mounted the injectors farther upstream in the throttle-body housing.

Front-Wheel-Drive Milestones

- **1929 Cord L29:** First front-drive car sold in the U.S.
- **1934 Citroën 7CV:** Combines front-drive and unibody construction.
- **1949 Citroën 2CV:** Arguably the car that first delivers front-drive benefits to the masses. The Deux Chevaux remains in production until 1990, exceeding 5 million examples.
- **1959 Morris Mini Minor:** Drafts the packaging template for modern front-drivers by mounting a transverse, water-cooled four-cylinder under its hood.
- **1966 Oldsmobile Toronado:** GM's first real attempt at front-wheel drive has a V-8 and becomes the first production car to demonstrate that front-drivers could be both large and alluring. Says *C/D* in November 1965: "The Toronado . . . may finally break down the orthodoxy and conformity that have gripped this country's auto industry since they gave up on steam."
- **1973 Honda Civic and 1975 Volkswagen Rabbit:** Both employ the most popular front-drive packaging still in use today, with a transaxle bolted to the end of a transversely mounted four-cylinder.

FUEL INJECTION ILLUSTRATION BY PETE SUCHESKI

top illustration by BRYAN CHRISTIE DESIGN

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Gas

by John Pearley Huffman

g A unit of measure for acceleration, commonly used to describe cornering grip. One g is equivalent to the rate at which any object accelerates when dropped at sea level. In a car cornering at 1.00 g, the driver is pushed against the side of the seat by a force equal to that of gravity keeping us stuck to the ground.

Gated Shifter A manual-transmission interface that defines the shift pattern with a plate featuring cutouts for the lever to slide into (as shown above on a Lamborghini Miura).

The United States burned through about 143.4 billion gallons of gasoline in 2016, according to the U.S. Energy Information Administration. That's a bit more than 1.2 gallons for each American—all 324 million of us—every day. When is this stuff going to run out?

While working in a Shell Oil research laboratory in 1956, M. King Hubbert predicted that United States oil production would peak between 1965 and 1970 and then constantly decline from there. He was kind of right. In 1970, U.S. production did reach a sort of high point at 9.6 million barrels a day. Some easy and some sophisticated extrapolation of Hubbert's theory to worldwide oil production resulted in "peak oil" predictions that saw 21st century civilization dissolving into *Mad Max*ian anarchy. And in 2008, when the U.S. was producing only 5.0 million barrels of crude oil per day, it all seemed scarily possible.

Then fracking, shale oil drilling, and a number of other technologies became practical. Since the 2008 low, U.S. oil production has increased so that by 2015 the country was pumping more than 9.4 million barrels a day. That dropped to 8.9 million barrels during 2016, as lower oil prices amid a worldwide glut discouraged production from marginal and expensive wells and sources. And there's currently more oil being extracted around the rest of the planet—with major producers having geopolitical reasons to keep pumping at high rates.

With the exception of a few "abiotic oil" theorists who believe petroleum isn't the product of decaying organic matter but comes rather from carbon deposits that have been part of the earth since it formed, the scientific consensus is that crude oil is still a finite resource that will eventually run out. It's just not going to happen anytime soon. In 2015, BP Group's head of technology said that with current extraction methods, the oil industry is capable of almost doubling known reserves by 2050.

Beyond all that, demand for oil is likely to fall. Even if governments weren't forcing it, the worldwide automotive fleet is becoming more fuel efficient, alternative energy sources are becoming more popular, and who knows what Elon Musk might come up with? [See "Tesla."] If any of us is alive when the last drop of dead dinosaur is pulled from the earth, we may not even care.

SHIFTER PHOTOGRAPH BY CHARLIE MAGEE

Greenhouse A design term that refers to the glass area of a vehicle.

GTI & GTO

Two performance icons with letters and humble beginnings in common. by Scott Oldham

Long before the legacy of John Z. DeLorean was dusted with cocaine, stainless steel, and the *Back to the Future* franchise, it was secured with three letters: GTO. In 1964, car guy DeLorean, then Pontiac's chief engineer, swiped those three letters from Enzo Ferrari and, along with the 389-cubic-inch V-8 from the brand's big Bonneville, turned the mid-size Pontiac Tempest into a factory muscle car. There were full-size hot rods from Detroit long before the Pontiac GTO, but DeLorean's smaller and lighter street-racer formula, combined with the marketing genius of Pontiac's legendary ad man Jim Wangers, kicked off a horsepower war that lasted nearly a decade and created the blueprint for street performance that still exists today.

Twelve years later, with big-block V-8s choked by emissions regulations and fuel shortages, Volkswagen reinvented street performance with four cylinders and three letters: GTI. The company dropped a fuel-injected 110-hp 1.6-liter inline-four from the Audi 80 into a Golf, lowered the car's suspension, and created one of the world's first hot hatches [see "H"]. The front-drive GTI was light and quick, and it cornered on three wheels. It hit Europe in 1976 but wouldn't arrive in the States until the 1983 model year. Strangulating emissions standards reduced the engine's output to 90 horsepower, but we still loved the GTI enough to loft it onto our first two 10Best lists [see "T"].

Now in its seventh generation, this little hatchback is still slaying giants and inspiring compact performance cars from numerous carmakers.

Above: In 1983, the GTI's 90 horsepower felt hot, hot, hot. Below: Pontiac stuffed the big Bonneville's 348-hp V-8 into the Tempest and started a revolution.

GTO photograph by JOHN ROE

Hatches, Hot

Pitted against the 350-hp all-wheel-drive Ford Focus RS, the Honda Civic Type R makes a case for the front-wheel-drive performance car. by Eric Tingwall

photography by Charlie Magee

◀ **HONDA CIVIC TYPE R**
Price: $34,775
Power: 306 hp
Torque: 295 lb-ft
Weight: 3137 lb
0–60 mph: 5.2 sec

▲ **FORD FOCUS RS**
Price: $39,780
Power: 350 hp
Torque: 350 lb-ft
Weight: 3465 lb
0–60 mph: 4.5 sec

Making power is but one variable in going fast. The upper echelon of performance—occupied by the mega-output Germans, big-muscled Corvettes and Hellcats, and, of course, Italian exotica—now depends on automatic transmissions, launch control, track-bred tires, and often all-wheel drive to generate stupefying performance.

That same phenomenon is just beginning to play out in our beloved hot-hatch segment, a first step on the factory-hot-rod ladder onto which go-fast technology slowly but surely trickles. With the spiciest hatchbacks making roughly 300 horsepower, the major players have turned to all-wheel drive to provide some relief to the front tires. In our May 2016 issue, the Ford Focus RS claimed the belt by defeating the Volkswagen Golf R and the Subaru WRX STI (okay, the Subaru isn't a hatch, but it should be one).

Honda, however, still sees merit in the original front-wheel-drive formula. The company's new Civic Type R, imported to the U.S. for the first time in the nameplate's 20-year history, suggests that lighter weight and a lower price are enough to offset the straight-line traction advantage of all-wheel drive. To see if that notion has merit, we've pitted the Type R against the reigning champ in a battle of turbocharged four-cylinder hatchbacks. The Honda's 2.0-liter produces 306 horsepower to the 2.3-liter Ford's 350.

The single-spec Type R goes for $34,775; its equipment list includes satellite radio, a proximity key, and dual-zone climate control. Navigation, audio, and some climate controls run through a standard seven-inch touchscreen, while the only transmission, a six-speed manual, keeps the turbocharged Type R tethered to the analog world. Honda's Type R adheres to the simpler, original hot-hatch formula with just one modern assist: a rev-matching algorithm that will blip the throttle on downshifts. We prefer to turn it off for the challenge and satisfaction of heel-and-toe downshifting [see "H"].

Ford's Focus RS will soon end its three-year production run with 1500 special-edition 2018 models that add a limited-slip front differential and a black roof among other cosmetic tweaks. Our tester is not that car. Instead, we have a $36,995 Focus RS with the $2785 RS2 package, which adds heated seats, a heated steering wheel, a power driver's seat, and navigation. RS buyers can also spend $1990 on Michelin Pilot Sport Cup 2 tires that are best reserved for track use. Our comparo contender is shod with the standard street-friendly Michelin Pilot Super Sport rubber.

We relocated to Pennsylvania's Allegheny National Forest—due north of the Westmoreland factory where Volkswagen sparked the hot-hatch movement 34 years ago by building the first GTIs [see "GTI & GTO"] for the United States—to pick a winner, and then struggled to do exactly that.

2. Ford Focus RS

There can be no draw in a *Car and Driver* comparison test. To the editors who weighed in on this particular face-off, this unwritten rule now seems as arbitrary and unjust as the one that says we can't bring pet parakeets into the office. Because after we crunched the test numbers, cast our ballots, and topped the fuel tanks for the final time, the scorecard showed a dead heat, a conclusion that fittingly captured our affinity for both cars.

Ford's Focus RS rides to near victory on the strength of its 350-hp inline-four. The 2.3-liter is equal parts raucousness and polish, a four-pot Ric Flair. Even though torque peaks at a relatively high 3200 rpm, the Focus lands at its 350-lb-ft plateau on a steady

Can't stomach the Type R's boy-racer filigree but don't want a car quite as understated as the Golf R? The powerful Focus RS is the hot hatch for you.

swell rather than the laggy bog-and-surge that's common with high-output boosted four-cylinders. This steroidal Focus launches from its 6700-rpm fuel cutoff with graceful clutch engagement and a light chirp of the front tires, resulting in a 4.5-second zero-to-60 slingshot. On overrun, the engine sounds like Satan's own popcorn maker. And as proof that Honda's resurgence is not yet complete, the Ford has the more satisfying shifter with fluid movements. The heftier clutch gives better feel through the friction point, too.

You don't buy an all-wheel-drive car for its ability to drift, and the Focus RS is no exception. Drift mode only makes momentary overtures at sustained tire-decimating slides. The RS's torque-vectoring rear differential does help the 3465-pound Ford dive into corners with a playful eagerness. The Focus's 0.99 g of lateral stick and 160-foot stopping distance can't match the Civic's performance, but the precision in the Ford's controls and the reckless abandon the car invites make every squiggle of pavement just as remarkable.

You pilot the Focus from a tall and upright seating position similar to a crossover's, and from this perch, you're well aware that both the Focus's roof and its center of gravity sit substantially higher than the Type R's. The snug Recaro buckets—too snug for some—are endlessly supportive with enough adjustability for all-day comfort. Deep cutouts on the back side of those front seats make for decent rear legroom in a car with a two-inch-shorter wheelbase than the Civic's, and the Focus delivers more rear headroom than the Honda. We've complained about the busyness of the audio and climate controls in prior Focus RS tests, but that's a bluff. We'd happily spin plywood knobs if it meant fewer controls migrated to touchscreens. Compared with the Honda,

Ford Focus RS
[+] Big output, seamless power delivery, and all the right noises.
[–] Pogo-stick ride quality.
[=] A riot on a twisty road and a nuisance on the highway.

	2017 FORD FOCUS RS	2017 HONDA CIVIC TYPE R
PRICE AS TESTED	**$39,780**	**$34,775**
BASE PRICE	$36,995	**$34,775**
DIMENSIONS		
LENGTH	172.8 in	179.4 in
WIDTH	71.8 in	73.9 in
HEIGHT	58.0 in	56.5 in
WHEELBASE	104.2 in	106.3 in
FRONT TRACK	61.6 in	63.0 in
REAR TRACK	60.6 in	62.7 in
INTERIOR VOLUME	**F:** 53 cu ft **R:** 38 cu ft	**F: 55 cu ft R: 42 cu ft**
CARGO BEHIND	**F:** 44 cu ft **R:** 20 cu ft	**F: 46 cu ft R: 26 cu ft**
POWERTRAIN		
ENGINE	turbocharged DOHC 16-valve inline-4 138 cu in (2261 cc)	turbocharged DOHC 16-valve inline-4 122 cu in (1996 cc)
POWER HP @ RPM	**350** @ 6000	306 @ 6500
TORQUE LB-FT @ RPM	**350** @ 3200	295 @ 2500
REDLINE/FUEL CUTOFF	6750/6700 rpm	7000/7000 rpm
LB PER HP	**9.9**	10.3
DRIVELINE		
TRANSMISSION	6-speed manual	6-speed manual
DRIVEN WHEELS	all	front
GEAR RATIO:1/ MPH PER 1000 RPM/ MAX MPH	❶ 3.23/5.6/37 ❷ 1.95/9.3/63 ❸ 1.32/13.8/92 ❹ 1.03/17.5/117 ❺ 1.13/22.6/151 ❻ 0.94/26.7/165	❶ 3.63/5.1/35 ❷ 2.12/8.7/61 ❸ 1.53/12.0/84 ❹ 1.13/16.3/114 ❺ 0.91/20.1/141 ❻ 0.74/24.9/169
FINAL-DRIVE RATIO:1	4.06, 2.96,* torque-vectoring rear diff	4.11, limited-slip diff
CHASSIS		
SUSPENSION	**F:** struts, coil springs, anti-roll bar **R:** multilink, coil springs, anti-roll bar	**F:** struts, coil springs, anti-roll bar **R:** multilink, coil springs, anti-roll bar
BRAKES	**F:** 13.8-inch vented disc **R:** 11.9-inch disc	**F:** 13.8-inch vented, cross-drilled disc **R:** 12.0-inch disc
STABILITY CONTROL	fully defeatable, competition mode, launch control	fully defeatable, competition mode
TIRES	Michelin Pilot Super Sport 235/35ZR-19 (91Y)	Continental SportContact 6 245/30ZR-20 90Y

CAR AND DRIVER TEST RESULTS

ACCELERATION		
0–30 MPH	**1.5 sec**	2.1 sec
0–60 MPH	**4.5 sec**	5.2 sec
0–100 MPH	**12.5 sec**	12.8 sec
0–130 MPH	**24.9 sec**	25.3 sec
1/4-MILE @ MPH	**13.4 sec** @ 103	13.9 sec @ **104**
ROLLING START, 5–60 MPH	**5.7 sec**	5.9 sec
TOP GEAR, 30–50 MPH	**8.5 sec**	10.3 sec
TOP GEAR, 50–70 MPH	**6.0 sec**	6.9 sec
TOP SPEED	165 mph (gov ltd, mfr's claim)	**169 mph** (drag ltd, mfr's claim)
CHASSIS		
BRAKING, 70–0 MPH	160 ft	**146 ft**
ROADHOLDING, 300-FT-DIA SKIDPAD	0.99 g	**1.03 g**
610-FT SLALOM	45.4 mph	**46.1 mph**
WEIGHT		
CURB	3465 lb	**3137 lb**
%FRONT/%REAR	59.3/40.7	61.8/38.2
CG HEIGHT	21.5 in	**20.5 in**
FUEL		
TANK	**13.9 gal**	12.4 gal
RATING	93 octane	91 octane
EPA COMBINED/ CITY/HWY	22/19/25 mpg	**25/22/28 mpg**
***C/D* 1050-MILE TRIP**	24 mpg	**26 mpg**
PRACTICAL STOWAGE		
NO. OF 9X14X22-IN BOXES, SEATS UP/FOLDED	5/14	**6/17**
LENGTH OF PIPE	119.0 in	**122.5 in**
LARGEST FLAT PANEL, LENGTH X WIDTH	61.0 x **40.3 in**	**66.5** x 33.5 in
SOUND LEVEL		
IDLE	45 dBA	**43 dBA**
FULL THROTTLE	86 dBA	**85 dBA**
70-MPH CRUISE	**74 dBA**	75 dBA

**The first ratio is for gears 1–4, the second is for 5 and 6.*

tested by ERIC TINGWALL *in Chelsea, MI*

the Focus offers more tactile controls for the crucial functions.

The Focus RS only met its defeat on the five-hour drive from Pennsylvania to our Michigan home office. Forced to choose a winner, we docked the RS another point for its spirit-sapping ride. Stiffly sprung, the car pogos over expansion joints, making pecs jiggle like B-cups and heads bob like cheap baseball-game giveaways. Tapping the end of the turn-signal stalk activates a stiffer damper setting that only harshens the already rough ride. Driving a Focus RS is a never-ending party. Maybe we're getting old, but we're not sure we could do it every day.

1. Honda Civic Type R

Don't interpret the one-point spread in this comparison test to mean that the Focus RS and the Civic Type R are similar. They're not. These two cars arrive at hot-hatch greatness by different roads. While the Ford powers in on the merits of its engine, the Honda owes its win to its chassis. Just look at the numbers: The Civic Type R hauled itself to a stop from 70 mph in 146 feet and stuck to the skidpad at 1.03 g's. A minimally optioned stick-shift Porsche 911—a $96,650 Porsche 911—musters 1.00 g and stops in 145 feet.

Building on the competence of the 10th-generation Civic chassis and the potential teased with the Civic Si, the Type R completes the package with the full 306-hp might of Honda's new turbocharged 2.0-liter inline-four. This is a freakishly quick front-wheel-drive vehicle when thrown down a challenging road. No other automaker sells a car like it.

In a straight line, our comparo car cracked 5.2 seconds to 60 mph and 13.9 seconds through the quarter-mile. We hit 4.9 seconds and 13.5 seconds, respectively, with the first Type R we tested. That car, though, was also almost a full second quicker in both of its top-gear passing tests, suggesting it may have been packing more ponies.

That the Type R, on its sticky 30-series tires, sweeps our chassis tests is no big surprise. That it also rides much more comfortably than the Ford is impressive.

Honda Civic Type R
[+] Corners, steers, and rides with poise.
[–] Aftermarket styling installed from the factory.
[=] Yes, front-wheel drive can be fast.

The Type R drives its 295 pound-feet of torque through a helical limited-slip differential and Continental SportContact 6 summer tires that deliver dogged traction at a price. Replacements cost $321 each and the Type R's window sticker warns that they may wear out in less than 10,000 miles. Honda's traction control can be a bit heavy-handed, perhaps in consideration of the tires' capability. The system preemptively cuts power any time the car gets light over a crest. Of course, if you turn the electronic minders off, no front-wheel-drive or all-wheel-drive car will be as hilariously fun as a rear-driver when you abuse the right pedal.

While still palpable, torque steer is well damped thanks to a strut-type front end that separates steering and suspension geometry, similar to Ford's RevoKnuckle in the prior-generation (and not-for-U.S.-sale) front-wheel-drive Focus RS. The steering weights up perfectly—a touch lighter than the modern Ford's—and the brake pedal's action matches the immediacy of the binders. After flogging the Focus (and the Focus flogging us back), we always found welcome relief for compressed spines in the Type R's compliant ride.

The Type R's flaws are plain to see for anyone over the age of 19. The designers appear to have drawn inspiration from fly swatters, anime hairstyles, and suspicious growths.

Even the Honda's plastic engine cover is flashier than the Ford's. Yet, somehow, the Type R's lump makes significantly less horsepower.

And the interior team must have used their year's allotment of red Sharpies coloring the seats and the lower half of the steering wheel, because they all but stopped at the B-pillar, dressing the rear only with perfunctory red stitching and belts. On the upside, think of all the money you'll save when you can't find a more garish fiberglass body kit for your Honda.

This being a Honda, even this hottest Civic could reasonably pull double duty as a family car. The Type R delivers the legroom of a mid-size car and, because it's 2.1 inches wider than the Focus RS, the rear seats feel significantly more airy. That sensation is helped by Honda's inexplicable decision to remove the middle seatbelt from all Type Rs and place shallow cupholders where the fifth passenger's butt normally goes. Despite the sloping hatch eating into cargo space, the Civic offers more cargo capacity than the Focus, with a lower load floor and more space behind the rear seats. And the ride is grandma-friendly.

Pragmatism and performance endure as the hallmarks of the hot hatch. While the trend toward all-wheel drive builds on both virtues with all-weather usability and performance-enhancing grip, Honda's Civic Type R proves that the original formula still holds as much potential as it did in 1983. The front-wheel-drive performance car isn't dead yet.

FINAL RESULTS

Shell V-Power NITRO+ Premium Gasoline
The Official Fuel of CAR AND DRIVER

	Maximum points available	HONDA CIVIC TYPE R	FORD FOCUS RS
RANK		**1**	**2**
VEHICLE			
DRIVER COMFORT	10	**10**	8
ERGONOMICS	10	7	**9**
REAR-SEAT COMFORT	5	**4**	**4**
REAR-SEAT SPACE*	5	**5**	4
CARGO SPACE*	5	**5**	4
FEATURES/AMENITIES*	10	6	**10**
FIT AND FINISH	10	7	**9**
INTERIOR STYLING	10	6	**8**
EXTERIOR STYLING	10	6	**10**
REBATES/EXTRAS*	5	0	0
AS-TESTED PRICE*	20	**20**	17
SUBTOTAL	100	**76**	**83**
POWERTRAIN			
1/4-MILE ACCELERATION*	20	18	**20**
FLEXIBILITY*	5	**5**	4
FUEL ECONOMY*	10	**10**	8
ENGINE NVH	10	8	**10**
TRANSMISSION	10	8	**10**
SUBTOTAL	55	**49**	**52**
CHASSIS			
PERFORMANCE*	20	**20**	18
STEERING FEEL	10	**10**	9
BRAKE FEEL	10	**10**	8
HANDLING	10	**9**	**9**
RIDE	10	**10**	5
SUBTOTAL	60	**59**	**49**
EXPERIENCE			
FUN TO DRIVE	25	**25**	24
TOTAL	240	**209**	**208**

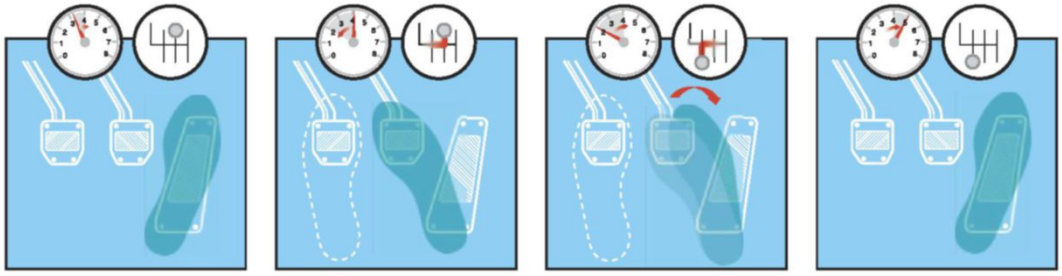
*These objective scores are calculated from the vehicle's dimensions, capacities, rebates and extras, and/or test results.

Hemi
Shorthand for an engine with a hemispherical combustion chamber. Advantages include being able to answer yes to: "That thing got a hemi?"

Horsepower
The unit of engine power. One horsepower is equivalent to the power needed to lift 550 pounds one foot off the ground in one second, or to lift one pound 550 feet in one second.

Heel-and-Toe Downshifting

A technique used in manual-transmission vehicles to smooth downshifts while decelerating by matching the engine revs to the speed of the transmission input shaft. Heel-and-toe shifting allows the driver to smoothly select the correct gear just before entering a corner. Here's how it's done:



Headed down the straight, the throttle is pinned, all eight cylinders are firing, and life is good. Eye the corner and begin to think about braking.

Apply the brakes, push in the clutch, and shift to neutral. Continuing to brake, position the heel or outer edge of your right foot over the throttle.

Keep braking! Meanwhile, blip the throttle to raise the engine revs as you select a lower gear. Release the clutch before the revs drop again.

Get back on the gas and steer. Being in the right gear allows the driver to fine-tune the chassis balance and power out of the corner.

Hybrids

Hybrids, the kind with an electric motor and *an engine, are the nerdiest of vehicles. Which got us thinking: Why not group all of them (at least the ones we remember) into a table that would make Dmitri Mendeleev proud? Unlike the periodic table of elements, this table of hybrids isn't organized by the number of protons but rather by common or shared hybrid traits. We hope it gives you a better understanding of the hybrid universe. Have fun, nerds.* by David Beard and Tony Quiroga

– PETROLEUM DISTILLATES
– PRIUS-OIDS
– UBER-READY TRANSPORTS
– EUROPEAN UNION-OIDS
– DOMESTIC METALS
– OBVIOUS-OIDS
– JAPANDROIDS
– NOBLE SPORTS
– PLUG-IN VEHICLES

1 P TOYOTA PRIUS																	2 Z HONDA CR-Z
3 Og PORSCHE SEMPER VIVUS	4 C TOYOTA PRIUS C											5 E FORD ESCAPE	6 Fo MAZDA TRIBUTE	7 Y TOYOTA HIGH-LANDER	8 N NISSAN PATHFINDER	9 V NISSAN MURANO	10 L LEXUS LC500h
11 T PIEPER VOITURETTE	12 Ds HONDA INSIGHT											13 W BMW X5 xDRIVE40e	14 Yu GMC YUKON	15 Q NISSAN ROGUE	16 U TOYOTA RAV4	17 Nx LEXUS NX300h	18 Cf BMW i8
19 M WOODS MODEL 44	20 Hy HYUNDAI IONIQ	21 Cv HONDA CIVIC	22 A HONDA ACCORD	23 R TOYOTA CAMRY	24 Al NISSAN ALTIMA	25 S SATURN AURA	26 B CHEVY MALIBU	27 F FORD FUSION	28 Hg MERCURY MILAN	29 Ha HYUNDAI SONATA	30 K KIA OPTIMA	31 Xh BMW X6 ACTIVE-HYBRID	32 Lk CHEVROLET TAHOE	33 At CHRYSLER ASPEN	34 Dp SUBARU CROSSTREK	35 Rx LEXUS RX400h	36 Ns ACURA NSX
37 O OWEN MAGNETIC	38 J VW JETTA	39 Av TOYOTA AVALON	40 Hs LEXUS HS250h	41 Ch LEXUS CT200h	42 Es LEXUS ES300h	43 G LEXUS GS450h	44 Ls LEXUS LS600hL	45 Qh INFINITI Q50	46 Fi INFINITI Q70	47 Ac ACURA ILX	48 Ah ACURA RLX SPORT HYBRID	49 Ml MERCEDES ML450	50 Aq AUDI Q5	51 Du DODGE DURANGO	52 Tm GMC SIERRA	53 Qx INFINITI QX60	54 Mc McLAREN P1
55 Tl TOWNS MICRODOT	56 Pv TOYOTA PRIUS V	57-71	72 Tr AUDI A3 SPORTBACK E-TRON	73 Pp PORSCHE PANAMERA E-HYBRID	74 Cm FORD C-MAX ENERGI	75 Tp TOYOTA PRIUS PRIME	76 Iq HYUNDAI IONIQ	77 Pa CHRYSLER PACIFICA	78 H HONDA CLARITY	79 Li CHEVROLET VOLT	80 Ir BMW i3 REX	81 Mg MERCEDES GLC350e	82 Pc PORSCHE CAYENNE S E-HYBRID	83 Vt VW TOUAREG	84 Cs CHEVROLET SILVERADO	85 Md ACURA MDX SPORT HYBRID	86 Pn PORSCHE 918 SPYDER
87 X GM XP-883	88 Ni KIA NIRO	89-103	104 Mb MERCEDES C350e	105 Bw BMW 330e	106 Mw BMW 740e	107 Sc MERCEDES S550e	108 We BMW 530e	109 Vl VOLVO S90 T8	110 Ct CADILLAC CT6	111 Bs FISKER KARMA	112 El CADILLAC ELR	113 Ge MERCEDES GLE550e	114 Xc VOLVO XC90 T8	115 Vo VOLVO XC60 T8	116 Mi MINI COUNTRYMAN S E ALL4	117 Rh LEXUS RX450h	118 La FERRARI LaFERRARI

CONCEPTIDES –

57 Fu FORD U	58 Su SUBARU B9 SCRAMBLER	59 Ku MAZDA SENKU	60 Yo TOYOTA Hi-CT	61 Od DODGE RAM 1500	62 Rr FERRARI 599GTB HY-KERS	63 Lo LOTUS EVORA 414E HYBRID	64 Re MAZDA 2 RE RANGE-EXTENDER	65 Kc KIA CROSS GT	66 Kr FISKER ATLANTIC	67 Ig INFINITI EMERG-E	68 Bo LAMBO ASTERION	69 Bt BENTLEY EXP 10 SPEED 6	70 Au AUDI Q8	71 Oh MERCEDES-AMG PROJECT ONE

RACECARIDES –

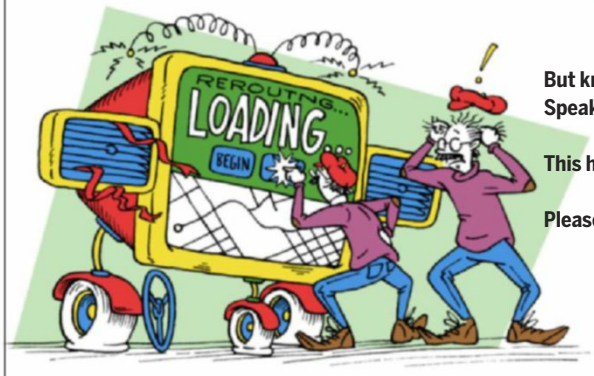
89 Ar TOYOTA LANDSPEED PRIUS	90 Zr HONDA CR-Z BY HPD	91 Px ACURA NSX TA2	92 Po McLAREN P1-GTR	93 Xx FERRARI FXX K	94 Ap PORSCHE 911 GT3 R HYBRID	95 Ze NISSAN ZEOD RC	96 Gt NISSAN GT-R LM NISMO	97 Lm AUDI R18 E-TRON QUATTRO	98 Fa RENAULT R29	99 Ho McLAREN-HONDA MCL32	100 Sv FERRARI SF70H	101 Lh MERCEDES-AMG W08 EQ POWER+	102 Ts TOYOTA TS050	103 Hh PORSCHE 919

Whatever.
Wherever. Whenever.
RAV4 comes standard with readiness for everything, from a weekend-long camping trip to a winter-long cross-country ski trip, and almost anything that Mother Nature can throw at it in between. Its available All-Wheel Drive will lead you confidently from adventure to adventure — whatever, wherever and whenever.
TOYOTA
RAV4
ADVENTURE GRADE
TOYOTA
Let's Go Places
Prototype shown with options. Dramatization. Do not attempt. ©2017 Toyota Motor Sales, U.S.A., Inc.

Infotainment

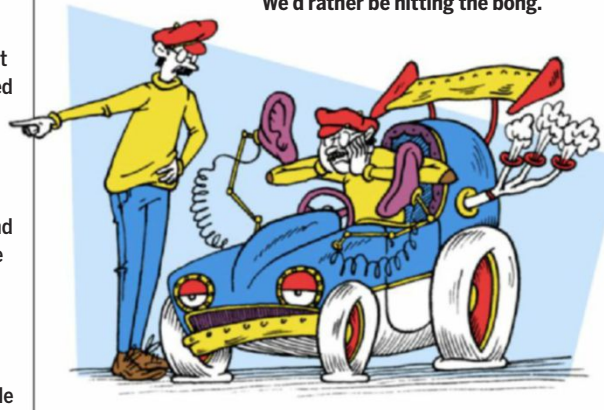
Pair your phone, tune the radio, work fast, or find the closest Maaco. by Josh Jacquot

Never use a screen when a knob will work.
Really, never use a screen when a knob will work.
Because a screen is fiddly and lacking precision,
But a knob, well, it provides such concision.
You'll find that when a car is moving,
A touchscreen is always confusing.



Screens make us crazy since we're always a-tapping,
But knobs make us happy even if they're worse for mapping.
Speaking of mapping, here's one more groan:
We want our cars as quick as our phones.
This hardly seems to be asking too much,
Especially in a world where we never declutch.
Please, we beg you, make our cars as quick as our phones.
Really, we mean it, please hear our moans.

Never use a haptic button.
Really, never use a haptic button.
They confound our thinking and are always hard to find,
Really, have you tried one? You might as well be blind.
Yes, it has a smooth finish, and it never looks cheap,
But just try to use it, we swear that you'll weep.
And the pulsing? Come on,
We'd rather be hitting the bong.



Please don't make us talk to our cars.
Really, don't make us talk to our cars.
We know your engineers think it's terrific,
But speaking to a machine is always somnific.
They never discern and they're maddeningly robotic,
Truly, speaking to machines makes us want a narcotic.
And they rarely ever listen like stars,
So please don't make us talk to our cars.

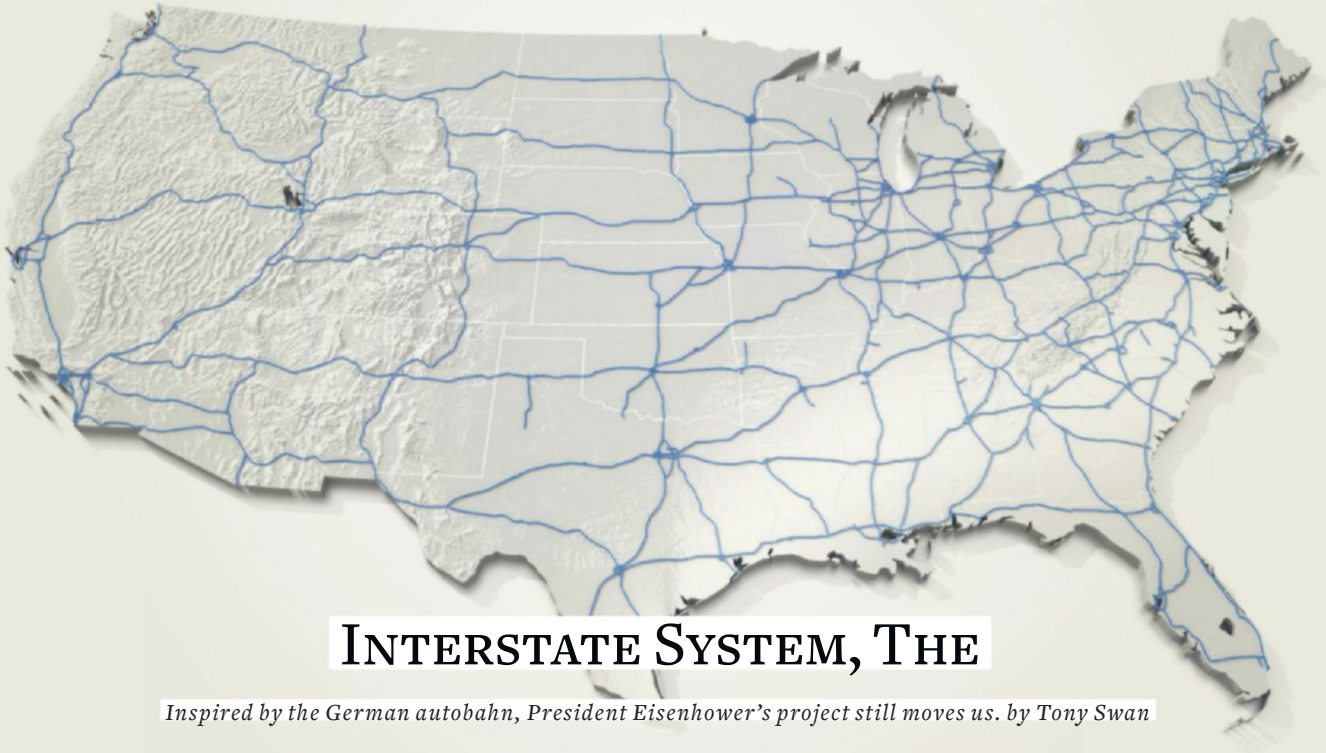
Listen, here's how you make a system that works.
Really, here's how you make a system that works.
Say no to haptics, slow screens, and miserable mapping,
Avoid volume buttons and talking and all that dull tapping.
None of these features are ever the best,
So please, for our sake, just give them a rest.
And if you find you've got space for only one knob,
Make it for volume and we'll tell you, "Good job!"

Ignition

SCANDAL In 2002, a GM engineer signed off on an ignition switch that failed to meet the company's torque specifications. Twelve years later, that decision would bite GM in the ass. Hard. News broke in 2014 that the ignition switch could slip out of the "run" position and into "accessory" or "off," stopping the engine, cutting the steering's power assist, and preventing airbag deployment. In the many resulting crashes, at least 124 people died and hundreds more were injured. Recalls started with the Chevrolet Cobalt and Pontiac G5 but have spread to around 29 million cars worldwide. GM has paid out at least $870 million to settle claims plus another $900 million to the federal government in a deferred-prosecution agreement over failing to disclose the safety defect to NHTSA.

illustrations by NATHAN YODER

Intercooler A heat exchanger that reduces the temperature of engine intake air that has been heated due to the compression of a turbocharger or supercharger. Cooling the air before it enters the intake manifold increases its density and allows the engine to make more power.



Interstate System, The

Inspired by the German autobahn, President Eisenhower's project still moves us. by Tony Swan

The interstate highway system was officially born on June 29, 1956, when President Dwight D. Eisenhower signed the Federal-Aid Highway Act. Eisenhower's interest in the concept was piqued during his tour of the German autobahn system in World War II, when he was Supreme Commander of the Allied Forces in Europe. Initially, he saw its significance in terms of military logistics. Today, almost everything we use in daily life—food, apparel, furniture, appliances, tools, building materials, medical supplies, you name it—has spent some time on an interstate highway on its way to us.

Distance: On its 60th anniversary, the system boasted 47,662 miles of expressway, including several east-west (even-numbered) and north-south (odd-numbered) transcontinental routes.

Traffic: Though they make up only 2.5 percent of U.S. roadway lane miles, interstates carry 25 percent of all traffic and more than 50 percent of truck traffic, transporting nearly $14 trillion in goods and products annually.

Origin: Its official name, the Dwight D. Eisenhower System of Interstate and Defense Highways, came about in 1990, but the system's origins date back to a 1939 Bureau of Public Roads report to Congress called "Toll Roads and Free Roads" and the Federal-Aid Highway Act of 1944, which laid out the concept and specified a total system size of 40,389 miles.

Usage: Some have called the interstate system the most ambitious public works project since the Roman Empire. The number of vehicles in the U.S. has increased from 65 million in 1956 to more than 260 million in 2015. The number of miles logged annually by U.S. vehicles during that span has expanded from 626 million to approximately 3 trillion.

Money: Construction costs have been estimated at $235 billion in today's dollars. The feds picked up nearly 90 percent of that tab. Though prices vary, it costs about $8–$10 million to build one mile of four-lane highway in urban areas.

Speed: Although inspired by the autobahn, which still has stretches with no speed limit, today's interstate system has limits in all 50 states. Most of them are set to 70 mph, but 12 states post a max of 75 mph, and in Idaho, Montana [see "Autobahn of America, The"], Nevada, South Dakota, Texas, Utah, and Wyoming, limits go as high as 80 mph. Texas has an 85-mph limit (the highest in the U.S.), but it's on a state route, not an interstate.

Safety: People manage to get themselves killed on all types of roads. According to the National Safety Council, there were 40,200 road fatalities in 2016, a 6 percent increase from 2015. But you're more likely to survive a drive on an interstate highway than elsewhere. In 2014, the interstate fatality rate—deaths per 100 million vehicle miles—was 0.54, compared with 1.26 for all other road types.

Myth: "One in every five miles of the interstate is straight enough for a plane to land on in an emergency." While small planes do occasionally land on interstates, according to the DOT, there is no law or regulation specifying that any part of the design be able to handle an airplane.

illustration by BRYAN CHRISTIE DESIGN

Investigations

Over the course of 750 issues, C/D has uncovered a fair bit of carmaker sleight of hand. Here are four of the most egregious examples. by Csaba Csere

1985 Chevrolet Corvette

The '85 Vette represented a major upgrade for the fourth-gen (C4) model. It got more power and a suspension that worked nearly as well on the street as it did on the track. We immediately ordered a long-term tester and dispatched then associate editor Rich Ceppos to collect it as it rolled off the line at GM's Bowling Green factory. It was not a happy 30,000 miles (the length of our long-term tests at the time). The transmission, air conditioner, heater, ignition system, windshield wipers, and windows all misbehaved. Then it got worse. At the end of the test, we found a sheaf of work orders inside the car. After it was built in Bowling Green, Kentucky, our "factory-fresh" Corvette had been trucked to GM's proving grounds in Milford, Michigan, where the Corvette group scrutinized it and replaced any questionable components, such as its transmission, and returned it to Bowling Green to await Ceppos. In other words, the abysmal quality we experienced with the car was likely far better than what typical customers experienced.

1999 Ford SVT Mustang Cobra

Ever since there have been Mustangs, Ford has been building hot ones. In 1999, the hottest was the SVT Mustang Cobra, upgraded to 320 horsepower and 317 pound-feet of torque, respectively 15 and 17 more than its predecessor. Problem was, it ran 5.5 seconds to 60 mph. Based on previous Mustang tests, we figured it should have been closer to five flat and said so. Ford soon admitted that flashing in the production intake manifolds was compromising airflow. The company ended up installing new manifolds and fitting less restrictive mufflers to deliver the promised ponies.

2001 Mazda MX-5 Miata

Miatas have never been about power, but we were excited to learn that the 2001 Miata was getting a bump from 140 horses to 155. Then we tested one, and it was half a second slower to 60 mph than before. We called BS, and Mazda confessed that the 155 ponies were for a Japanese version that did not meet U.S. emissions regs. Actual output came in at 142 horsepower. To rectify the situation, Mazda offered to buy back all early 2001 models or else provide owners with free service for the remainder of their three-year/50,000-mile warranty plus a $500 debit card that could be spent anywhere, not just at a dealership on Zoom-Zoom–branded tchotchkes.

2009 Nissan NISMO 370Z

During our fourth running of Lightning Lap, a 2009 Nissan NISMO 370Z ended up in the tire wall after suffering brake failure at 130 mph. We dug into why it happened and weren't comforted by our findings: Nissan spec'd the NISMO's brake pads for their low-noise and low-dust characteristics and not for track use. Nissan introduced optional high-performance pads for the Z within months of our crash. We tested those pads and discovered that, while they could endure 12 or so more stops from 100 mph than the stock pads, the brakes still failed after only 24 stops. The brakes on a Porsche 911 or Corvette of the era could survive 45-plus stops with minimal fade. Thinking that the brake fluid had boiled on our Z, we switched to a higher-temp fluid and pushed the point of failure to 35 stops. We suggested upgrading the pads and fluid and adding brake-cooling ducts for trackbound Zs.

illustration by ANDY POTTS

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J-Turn
A 180-degree turn made famous by the TV shamus Jim Rockford. Accelerate in reverse, lift while spinning the steering wheel; as the car rotates, grab drive or first; complete spin, straighten the wheel, and go, man, go.

Jaguar
The British car company founded by Sir William Lyons is now owned by the Indian conglomerate Tata. Jag introduced its first SUV, the five-seat F-Pace, in 2016. A second, the compact E-Pace, is on its way.

JAPAN

QUALITY MAY BE THE LAND OF THE RISING SUN'S GREATEST EXPORT.

by Jeff Sabatini

Before "Made in China" signified cheap products, before "Made in Taiwan" meant shoddy goods, there was "Made in Japan." As the United States sought to help its former enemy rebuild after World War II, Japanese manufacturers had a reputation for poor quality. But they soon discovered statistical process control, a method for measuring and ensuring quality that was developed by Bell Laboratories decades earlier and championed in postwar Japan by the American engineer, statistician, and management consultant W. Edwards Deming.

Though their initial efforts at selling cars in the U. S. in the late 1950s went poorly, Japanese automakers kept at it. While working for Toyota, Taiichi Ohno and consultant Shigeo Shingo developed "lean production," which includes *kaizen* (or continuous improvement), waste elimination, and just-in-time manufacturing. Add that to Deming's focus on quality, and Japan's manufacturing capabilities were absolutely transformed.

American mass manufacture was turned on its head in the decades that followed. Not only did the Japanese begin building higher-quality cars than the Big Three, but their efficiency meant they were also able to bring new products to market in record time at comparatively low cost. The threat to the U.S. auto industry was so great that Japan agreed to restrict exports of cars in 1981. This led, in part, to Honda opening the first Japanese auto assembly plant in the United States the following year [see "Marysville, Ohio"]. Others, like Toyota and Nissan, soon followed.

But rather than destroy the American auto industry, the Japanese spurred change at Chrysler, Ford, and GM. Partnerships between Mitsubishi and Chrysler, Mazda and Ford, and Toyota and GM led the Americans to adopt many of the manufacturing and management principles of their Japanese partners. After the introduction of Acura, Infiniti, and Lexus, even the German automakers got on board in the 1990s, and today, *kaizen* is common practice in auto factories around the world.

JEEP

It's a black-widow thing.
by Daniel Pund

Remember the facehugger from the movie *Alien*? That was awesome, right? Well, we in the auto biz have our own facehugger. Its name is Jeep. Now, Jeep isn't gross and doesn't have a proboscis or acidic blood. But Jeep does have the tendency to send the company that owns it—let's call it a host company—to its death while it thrives. When was the last time you bought a Kaiser?

Willys-Overland (1941–1963)
What we now know as Jeep is born in 1941 at the behest of the federal government. Willys-Overland and Ford Motor Company essentially crib the design from American Bantam. This makes American Bantam both Jeep's parent and its first victim. The origin of Jeep's name is up for debate: Some say it's named after the *Popeye* comic-strip character Eugene the Jeep; others claim it's simply the phonetic combination of the letters G and P, the military abbreviation for general purpose. The name doesn't become official until 1950, when Willys is awarded a trademark for "Jeep." In 1953, Kaiser-Frazer purchases Willys-Overland for $62.3 million. Willys produces its last passenger car in 1955, but Jeep production continues. In 1963, the Willys name is dropped entirely and the company comes to be known as the Kaiser Jeep International Corporation.

Kaiser Jeep International Corporation (1963–1970)
In 1970, Kaiser sells to American Motors Corporation and gets out of the auto business entirely. Jeep survives.

American Motors Corporation (1970–1987)
By 1977, AMC is staggering along after losing $73.8 million over the previous two fiscal years. In 1977, Jeep sells a record 124,843 vehicles in the U.S.

Jersey Barrier A big concrete slab with distinct slanted sides. When placed end to end, they form a wall to safely control traffic flow or block you from getting too close to Bon Jovi.

illustration by KOTYNSKI

Renault (1979–1987)

The French company Renault buys into AMC in 1979.

Chrysler (1987–1998)

Chrysler, under the leadership of Lee Iacocca, buys American Motors for $1.5 billion in 1987. The prize is Jeep, which an analyst at the time estimates to be worth $850 million. A few years earlier, Jeep had introduced its most significant and popular model since the CJ (civilian Jeep): the XJ Cherokee. AMC becomes Jeep-Eagle. Eagle lasts about a decade before being euthanized. Jeep does just dandy. With the introduction of the Grand Cherokee for the 1993 model year, Jeep sales improve by 66 percent within the span of a year. For calendar year 1993, Jeep sales in the U.S. top 400,000 for the first time in the brand's history.

DaimlerChrysler (1998–2007)

In a "merger of equals," Daimler buys Chrysler for $36 billion in 1998. By then, Jeep reliably sells around half a million vehicles per year in the SUV-hungry U.S.

Cerberus Capital Management (2007–2009)

In 2007, eager to unload Chrysler, Daimler foists it off on a private equity firm that has zero experience running a car company but is named after the three-headed dog who, in Greek mythology, guards the entrance to the underworld. Oddly, this does not go well.

Fiat Chrysler Automobiles (2009–present)

In a scant two years, Cerberus-controlled Chrysler seeks bankruptcy protection and is rescued by the U.S. government. (Yes, the same government that ordered Jeep's creation in the first place.) The company emerges from bankruptcy thanks in large part to Fiat. Dodge sales decline, dropping from 594,865 in 2013 to 506,858 in 2016. Chrysler-brand sales slide from 302,995 to 231,972 during the same period. And Jeep? Well, in that time frame, its U.S. sales nearly double to 926,376 (with 1.4 million sold worldwide).

K-Car

Chrysler's savior gets no respect.
by James Tate

In the early '80s, Chrysler was saved from financial ruin by selling the front-drive K-car, a nice Reliant automobile that would spawn numerous inexpensive-to-produce variants. As disrespected as it was versatile, the lowly K-car spread its plebeian roots and survived until 1995. Cue the highlight reel:

1981–88 Plymouth Reliant Wagon

The Plymouth Reliant and its Dodge Aries counterpart came as coupes, sedans, and wagons, all with room for six. Although the wagon survived until 1988, it and almost all other wagons died out as a result of another K-based people mover, the minivan. Testing the '81 Wagon involved a sidewall-bending demonstration of understeer [see "U"].

1983–86 Chrysler LeBaron Town & Country Convertible

Lee Iacocca and George Costanza knew an icon when they saw one: Legend has Lido ordering the faux-wood–paneled LeBaron Town & Country convertible into production immediately after laying eyes on the prototype.

1983–86 Chrysler Executive Limousine

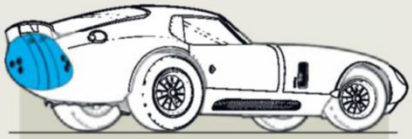
Hot off the energy crisis, making a silk purse out of the K-car's ear must've seemed like a winner. The Exec limo added over 30 inches to a K-car's wheelbase, perfect for cheap suits with long legs. Fuel prices fell, rendering this econo limo unnecessary, but what really killed it was the fact that it was a stretched K-car.

1984–95 Dodge Caravan/ Plymouth Voyager

The K-car's biggest trick was its transformation into the 1984 Caravan and Voyager—the first modern minivans. They were dubbed Magic Wagons for their magical ability to fit in a garage. Plus, Doug Henning was in the commercials, and what's more enchanting than that?

1991–92 Dodge Spirit R/T

The K-based Spirit R/T featured a 16-valve head by Lotus on top of the venerable Chrysler turbocharged 2.2-liter inline-four. Manual only, the R/T made 224 horsepower and hit 60 mph in 5.8 seconds on its way to a 141-mph top speed. The Spirit and its mate, the Plymouth Acclaim, were the final K-car derivatives and lasted until 1995.



Kamm Tail

Named for German designer/engineer Wunibald Kamm, the Kamm tail, or Kammback, refers to a streamlined car shape that is sharply cut off at the rear. The Kamm tail reduces aerodynamic drag by cleaning up turbulence at the back of the vehicle.

KAMM TAIL ILLUSTRATION BY PETE SUCHESKI

Keys

by David Beard

You've lost them and you've found them. The once humble key has grown up, gained utility, and may soon become obsolete. Here are some highlights of the key's evolution:

1949 Chrysler: While the first key that turned on a car's ignition arrived in the early 20th century, it required the push of a button to engage the starter. In 1949, Chrysler introduces the modern key that starts the car with a turn of the ignition tumbler.

1965 Ford: Ford brings out its double-sided key still used today in many modern cars. Unlike the single-sided keys preceding it, this one has cuts on both sides, allowing it to be inserted into the tumbler in either orientation.

1986 Chevrolet Corvette: To make the Vette harder to steal, Chevy adds a coded resistor to the key that is needed to start the car. This Vehicle Anti-Theft System trickles down to most GM cars by the '90s.

1987 Cadillac Allanté: The '83 AMC/Renault Alliance has the earliest example of factory-installed remote entry capable of locking and unlocking the doors that we could find. But we couldn't actually find one of these fobs, so we settled for that of another early adopter, the '87 Cadillac Allanté. By the early '90s, keyless-entry fobs are going mainstream, forever changing the lives of parking valets.

1990 Jaguar: Dubbed the Tibbe key, this odd shaft with an oval-shaped tip makes its first appearance in the 1989 Merkur Scorpio

before being widely used by Jaguar in the 1990s; it also makes its way into many Ford products. The Tibbe key reappears for the 2010–13 Ford Transit Connect before disappearing for good.

1990 Lexus LS400: One of the first uses of the laser-cut key. This design provides an additional layer of security, mainly because it's difficult to replicate.

1990 Mercedes-Benz SL: New for 1990, the Mercedes SL introduces a "switchblade" key that flips out of an integrated remote-locking fob. The design would be widely copied and continues to be used in most modern Volkswagens.

1993 Chevrolet Corvette: GM experiments with proximity-key technology in the '93 C4. Unlike proximity fobs of today, the Passive Keyless Entry system couldn't start the car—you still needed a traditional ignition key for that—but it could automatically lock and unlock the doors simply by detecting the fob close by.

2003 Mercedes-Benz: The first fully functional proximity key design is short-lived. Made for the 2003 model year to fit in a wallet like a credit card, Mercedes' Smart Card lacks durability. A year later, Mercedes-Benz adapts the technology to work in a more robust fob. In 2004, Lexus releases its own version of the Smart Card and still offers one on select models and also as an accessory.

2004 Chevrolet Malibu: Remote start has been available in the aftermarket world for years, but GM is the first carmaker to offer the technology direct from the factory, forever changing the way we warm and cool our vehicles.

2016 BMW: BMW's modern Display key makes its debut on the 7-series and attempts to mimic a smartphone by adding an LCD touchscreen. From 1000 feet away, the key can lock and unlock the doors, set climate control, and open the trunk. Via the touchscreen, the car can be parked even when there's no driver at the wheel. The display provides info about which lights are on, whether the doors are locked, fuel level, and when the next service is due. It charges using a micro-USB connection or wirelessly in the center armrest.

2018 Tesla: You may never receive your Model 3, but you might already have the key. Tesla's smartphone app makes BMW's Display key as obsolete and frivolous as a pair of Google glasses. Using Bluetooth low energy, the app is always running in the background, mimicking a proximity key. A credit-card-style key bails you out when your phone battery inevitably dies.

photography by ROY RITCHIE

Korea

A country becomes a global carmaking giant in just 30 years. by Joe Lorio

Korea as it relates to *C/D* is largely a story about industrial conglomerate Hyundai. Founded in 1967, Hyundai (Korean for modernity) began assembling Ford Cortinas under license in 1968. The company's first vehicle of its own design, the Mitsubishi-powered Pony, arrived in Korea in 1976. But it wouldn't be until the 1980s that Hyundai would sell a car in our market. Although the media of the '80s celebrated yuppies and their brand-conscious consumption of BMWs, there was then, as now, a vast population of price-driven Americans who were receptive to a new-car bargain, never mind its source. So when the 1986 Hyundai Excel—essentially a Giugiaro-bodied Mitsubishi Precis—burst onto the scene at the low, low price of $4995 (versus $6699 for a Honda Civic DX), Americans snapped up more than 150,000 of them. And the heretofore unknown nameplate sold more than 250,000 cars annually in its second and third years in the United States.

Starting at $4995 for '86, the Hyundai Excel ('88 shown) boasted a Giugiaro design and a 68-hp engine capable of calling up 60 mph in 16.3 seconds.

Three years, though, was all it took for Excels to start falling apart. Sales collapsed in 1989 and flatlined through much of the 1990s. In 1998, Hyundai's then president, Finbarr O'Neill, introduced a 10-year/100,000-mile powertrain warranty (5 years/60,000 miles, bumper to bumper) to assuage quality concerns. Sales of the now four-model lineup—Accent (the irredeemably tarnished Excel's replacement), Elantra, Sonata, and Tiburon—jumped a staggering 82 percent.

Meanwhile, fellow Korean automaker Kia followed Hyundai to the States in 1993, selling its $8495 Sephia sedan at select dealerships in the West. It achieved nationwide distribution within a few years, offering the Sephia and the compact Sportage SUV. Hyundai acquired Kia in 1998 but maintains separate marketing and sales operations for the two brands to this day.

Reading from Toyota's and Honda's playbooks, Hyundai established in 2005 a U.S. factory in Montgomery, Alabama; Kia opened a plant in West Point, Georgia, five years later [see "Marysville, Ohio"]. The two brands shared powertrains and platforms, but their positioning relative to each other was unclear. To change that, Hyundai brought in VW/Audi's Peter Schreyer as design chief in 2006. Schreyer made Kia styling a differentiator and a key to the brand's success. He now oversees design for both brands.

More critically, the decade-long push toward redemption that started in the 1990s helped Hyundai vanquish its quality woes. In 2006, the brand topped all other nonpremium makes in J.D. Power and Associates' Initial Quality Study, and although that study measures design and ergonomics as much as it measures vehicle defects, it still holds sway over many buyers' perceptions. Hyundai's increasing legitimacy enabled it to poach U.S. executive talent—though the ambitions of its Korean bosses often led to short tenures.

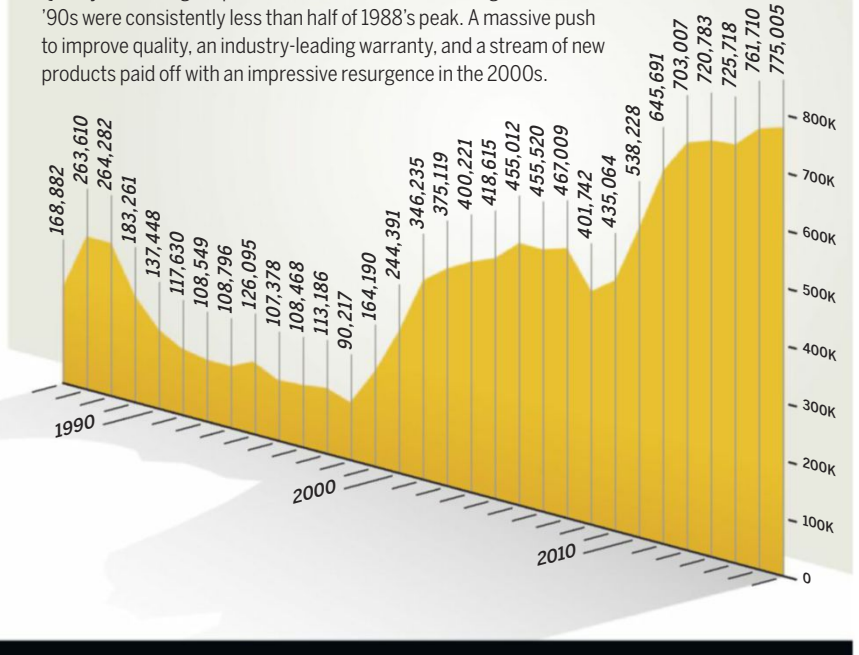
Those ambitions extended to the luxury segment, as first indicated by the 2001 XG300, then by the Toyota Avalon–like Azera five years later. Hyundai got serious with the 2008 addition of the Genesis sedan, built on the company's first modern rear-drive platform and powered by a newly designed V-8. A rear-drive Genesis coupe followed. Then came the larger and even pricier Equus—the $58,900 Lexus LS competitor included an iPad with the owner's manual preloaded on it along with an app to schedule service (with complimentary pickup and delivery, naturally).

Genesis is now its own luxury brand, its existing sedan assuming the G80 nameplate. It's joined by a new range-topping G90 sedan, with a G70 entry-luxury car on the way. And Hyundai continues to branch out in other directions. The new Ioniq, available as a hybrid, a plug-in hybrid, and an EV, clearly targets the Toyota Prius. Hyundai also has announced a performance subbrand: N.

The easy market-share gains may be in the past, as Hyundai's U.S. sales topped 750,000 cars last year, and Kia's neared 650,000. But 31 years after its arrival, Hyundai is now as ensconced in the U.S. as aging yuppies and BMW.

Hyundai's U.S. Sales, 1986 to 2016

In its first seven months in the U.S., Hyundai sold 100,000 Excels. Quality woes caught up with the brand, and sales throughout the '90s were consistently less than half of 1988's peak. A massive push to improve quality, an industry-leading warranty, and a stream of new products paid off with an impressive resurgence in the 2000s.



SUPERCAR HQ

When we set out to reinvent the NSX, our goal was to create not only the best supercar in the world, but also the best supercar factory in the world. That would mean reimagining how cars are made altogether—building a place where Acura's top engineers and technicians could experiment, design, and craft new technologies aimed at achieving an entirely new level of precision.

A place where workers develop their own processes, leading to over a dozen patents. A place where auto industry firsts are the norm, like our space-frame weld technique, in which the entire chassis is rotated so technician-trained robots can perform their nine hundred-plus surgically precise welds at the optimal angle. A place where every bolt is started by hand. A place with no repair area, as a car built from perfect parts and rigorously checked at every stage of the build should be perfect when it rolls off the line. A place where unequaled innovation and master craftsmanship collide. And all under a single roof in Marysville, Ohio. We call it PMC— the Performance Manufacturing Center.

This is the 2017 Acura NSX. And this is where we make it.

Check out the NSX at your local Acura dealer, or build your own at nsx.acura.com/build.

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Lab Results

SCANDAL The difficulty of getting diesel passenger vehicles through U.S. emissions standards was known long before Dieselgate. You remember Dieselgate, no? That was when Volkswagen adopted the audacious and illegal strategy of simply ducking U.S. emissions standards by installing a cheat code within the engine-management systems of its four- and six-cylinder diesel engines. VW programmed these systems to run in an emissions-compliant mode when the laboratory conditions of EPA testing were detected. A research group at West Virginia University was the first to highlight the huge discrepancy between lab and real-world performance, where VW Group products emitted as much as 40 times the legal amount of nitrogen oxides. Dieselgate promises to be one of the costliest corporate scandals ever, with VW having already allocated more than $30 billion for fixes and compensation, including a $2.8 billion fine for cheating on federal emissions tests.

Lemon Law

Each state has a law to protect consumers from defective vehicles. It forces the manufacturer to purchase or replace a vehicle after attempting and failing to fix it a set number of times in a given period.

Leaded Gas

How gas came to contain lead and why we don't miss it. by Scott Oldham

A filling station in Dayton, Ohio, sold the first gallon of leaded gasoline in February 1923. Thomas Midgley Jr. missed the event. The General Motors engineer who discovered that tetraethyl lead, also called TEL, raised the octane of gasoline, was in Miami, Florida, convalescing from severe lead poisoning.

Midgley and his boss, Charles Kettering, the man who patented the electric starter in 1911, had ignored the known health risks of lead. Exposure affects not only the nervous, cardiovascular, and immune systems, but it can also cause major behavioral issues and learning problems in young children.

But in engines, the toxic compound eliminated knock, which was an industry-wide problem at the time. TEL was held up as the protector of valve seats and high-compression engines. Kettering also knew it was a better bet for GM than ethanol, which had similar benefits but couldn't be patented.

The following year, 32 men at the Standard Oil Company of New Jersey became sick (in some cases, to the point of insanity), and five of them died from TEL exposure, triggering public backlash and an industry-backed investigation into the effects of TEL that proved to be a farce. Standard Oil's medical consultant claimed that the workers' deaths were "wholly unlike those of chronic lead poisoning such as painters often have."

Leaded gasoline was the primary fuel type produced and sold in America until 1975. Although cited as a reason for limiting the use of leaded gas, health issues associated with TEL exposure weren't what finally caused its removal after 52 years; it was tailpipe emissions. The use of catalytic converters [see "Environment"] became necessary to meet stricter emissions regulations outlined in the Clean Air Act of 1970, and leaded gasoline proved damaging to these devices. In 1975, catalytic converters were in and lead was out. New cars were sold with cats, hardened valve seats, and Unleaded Fuel Only labels. Virtually overnight, "Fill it up unleaded" became the request at gas stations across America.

Eventually, leaded gas became illegal in roadgoing vehicles, first in California in 1992 and then nationwide four years later. Despite many calling the valve-seat issue a myth, owners of older cars fearing engine damage scrambled to modify their cylinder heads. Today, the valve-seat debate still rages on across the internet.

Although *Time* magazine in 2010 called leaded gas one of the 50 worst inventions of all time, it's still sold in the U.S. for use in off-road vehicles, farm equipment, aircraft, race cars, and marine engines.

Letters

We didn't throw out your correspondence. Backfires will be back next month—Ed.

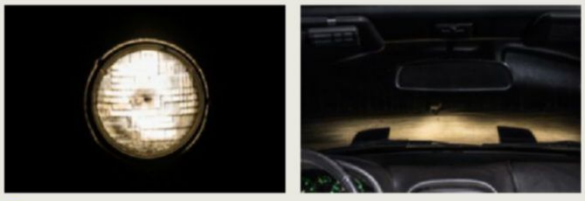
Light Test

Lunar Roving Vehicle

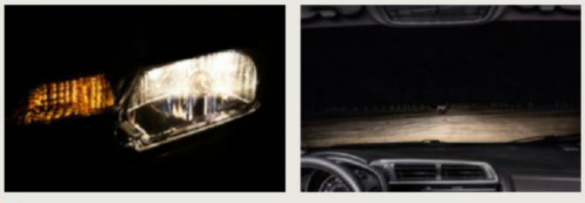
Americans love the automobile so much that we took a few into space. Designed by Boeing in the late '60s and largely built by GM in Santa Barbara, California, three Lunar Roving Vehicles went to the moon on the Apollo 15, 16, and 17 missions. A top speed of 11.2 mph gave the battery-powered rover the moon's land-speed record.

PHOTOGRAPH BY SSPL/GETTY IMAGES. ILLUSTRATION BY T.M. DETWILER

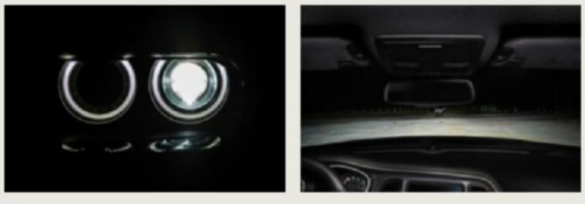
1916 Ford Model T Touring (incandescent headlights)



1997 Mazda MX-5 Miata (sealed-beam headlights)



2018 Honda Fit Sport (halogen headlights)



2018 Dodge Challenger GT AWD (HID headlights)

2018 Mercedes-Benz E400 4MATIC Coupe (LED headlights)

Lux quantifies the intensity of light as perceived by the human eye. City streets are typically illuminated to about 10 lux at night while the lights in a living room are roughly equivalent to 50 lux. An overcast day is usually around 1000 lux.

Lights

After more than a century of development, electric headlights are still constrained by the original conundrum: how to be bright without being blinding. by Eric Tingwall

From the moment electric headlights snuffed out kerosene and acetylene lamps in the 1910s, automakers have struggled to illuminate the road without blinding oncoming drivers. The industry's first unified effort to rein in glare was led by the carmakers themselves before the automobile was federally regulated. In the span of just two model years, 1940 and 1941, every new car in the United States adopted standardized seven-inch round headlights. These sealed-beam assemblies, combining the bulb, lens, and reflector into one unit, eventually expanded to include additional sizes and rectangular shapes, but the original seven-incher was still popping up in vehicles such as the 1990–1997 first-generation Mazda MX-5 Miata well after NHTSA had approved replaceable-bulb and nonstandard-shaped headlights in 1983.

Today's lighting regulations primarily dictate performance, allowing manufacturers to choose from a handful of technologies. High-intensity discharge (HID) lamps produce light with an electric arc in a gas-filled bulb rather than the filament used in conventional halogen bulbs. The latest trends favor energy-efficient light-emitting diodes (LED) and lasers. Both allow for precise control and placement of the beam, to the extent that some "smart" headlights can carve out a dark spot around an oncoming car.

Our test revealed that technology isn't the only factor in determining headlight performance. NHTSA allows headlights to be located between 22 and 54 inches from the ground yet also calls for a horizontally oriented cutoff to block the beam from angling upward into the eyes of approaching drivers. Mounting the headlights higher, then, is the only way to elevate the beam. That's exactly why the 1916 Ford Model T Touring we tested did such an admirable job exposing the body of our decoy deer at a distance of 100 feet [see top right] while several of our modern cars threw their light at the deer's feet. However, the T's crude reflectors created a narrow spot beam, barely wider than the car itself, and intensity fell off rapidly beyond 100 feet.

The 2018 Honda Fit's halogen bulbs are hardly an improvement on a 1997 Miata's sealed-beam lights. And at just 50 feet out from the car, the bright center of the Mercedes E400's beam passed below our light meter positioned 24 inches off the ground. The 305-hp Dodge Challenger GT AWD can't spin its own tires, but it was the Hellcat of headlights in our test. Its HID lamps flooded our testing field with the brightest light in each of the eight measurement locations. It helps that the all-wheel-drive Challenger has an SUV's stance.

THE TEST: WE MEASURED LIGHT INTENSITY, IN LUX, AT EIGHT LOCATIONS FOR EACH OF OUR FIVE TEST SUBJECTS.

photography by ANDI HEDRICK

Luxury, Japanese-Style

By the '80s, Japanese carmakers had figured out what affluent Americans really wanted. by Eddie Alterman

A lot can change when a new generation of Americans discovers its wallet. World War II resentment of the Japanese people meant that Americans in the immediate postwar era avoided Japanese goods. Japanese stuff was the original junk, and their cars were nothing but tin cans. At a certain moment in time, this was true [see "Japan"].

But it neglected the divergent trajectories of growth and ambition. When Americans were getting rich postwar, honing their appreciation for fancy cars and other signifiers of wealth, Japan was honing its blade.

This often meant exploiting some economic advantage. The first was the oil embargo of 1973, and Honda and Toyota had fuel-efficient commuter cars at the ready. When boomer Californians started buying them for the sake of home economics, they found that the cars weren't junk and they didn't break. Japanese cars flooded the West Coast and migrated east, rejections of old orthodoxies, symbols of frugality but also forgiveness.

Japan, Inc., saw another economic opportunity in the early '80s, when the gap between its currency and the rest of the world's was cosmically wide. With a weak yen and, by then, state-of-the-art production processes, Japanese carmakers realistically surmised that they could produce simulacra of German luxury cars for the American market at nearly half the price. (American luxury cars, by this time, had become complacent and shoddy but fooled their makers into thinking they were still competitive by dint of a robust dealer body. German cars were the new bogey.) Acura emerged first, more as an expression of Soichiro Honda's daring than anything else. But Toyota was more focused, pitting its first big luxury sedan against the world's best car: the Mercedes-Benz S-class. It worked. The 1990 Lexus LS400 looked almost like an S-class, drove almost like an S-class, and was quieter than an S-class. Who cared if it had no heritage? It was priced like an E-class.

And so set a pattern: Honda as Acura, Nissan as Infiniti, and Toyota as Lexus built reliable, refined, high-value cars to reshuffle the luxury-car deck. There were differences of dynamic tonality among the three, but none had any real backstory, no significant competition trophies in their cases. The thing was, they didn't break. And they exposed some important things about the people who buy luxury cars: By and large, they care a lot about their money, they care a lot about their time, and they care a lot about how they're treated. The first Acuras, Infinitis, and Lexuses—especially Lexuses—had great and accommodating dealers, and the cars were not finicky or pricey like their German counterparts. They didn't require much care and feeding. They just coddled and comforted. The first wave of the Japanese luxury invasion proved that frugality and forgiveness—mechanical in this case—were more important than history.

The first LS400 did what all watershed products do: force consumers to recalibrate their expectations and assumptions of an entire industry.

1990 Lexus LS400*

VEHICLE TYPE: front-engine, rear-wheel-drive, 5-passenger, 4-door sedan
PRICE AS TESTED: $39,563
BASE PRICE: $35,350
ENGINE TYPE: DOHC 32-valve V-8, aluminum block and heads, port fuel injection
DISPLACEMENT: 242 cu in, 3969 cc
POWER: 250 hp @ 5600 rpm
TORQUE: 260 lb-ft @ 4400 rpm
TRANSMISSION: 4-speed automatic
DIMENSIONS
WHEELBASE: 110.8 in
LENGTH: 196.7 in
WIDTH: 71.7 in
HEIGHT: 55.3 in
TRUNK VOLUME: 14 cu ft
CURB WEIGHT: 3750 lb

Car and Driver Test Results

ZERO TO 60 MPH: 7.9 sec
1/4-MILE: 15.9 sec @ 90 mph
TOP SPEED: 150 mph (drag limited)
BRAKING, 70–0 MPH: 188 ft
ROADHOLDING, 300-FT-DIA SKIDPAD: 0.79 g
FUEL ECONOMY
EPA COMBINED/CITY/HWY: 18/16/22 mpg
***C/D* OBSERVED:** 19 mpg

**Specs and results, November 1991.*

photography by JESSICA LYNN WALKER

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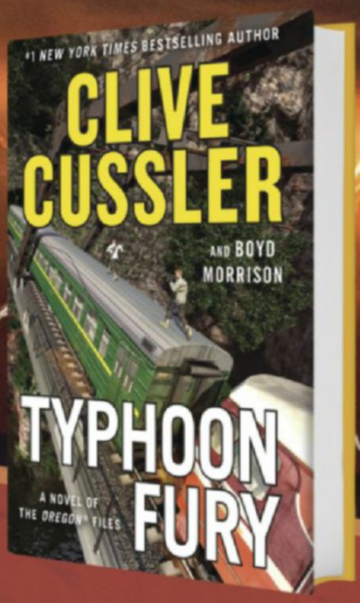
SET SAIL WITH THE GRAND MASTER OF ADVENTURE



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Marysville, Ohio

How the visitors became the home team.
by K.C. Colwell

Honda's assembly plant in Marysville, Ohio, has been churning out Accords for U.S. and Japanese consumption since 1982. In addition to the Accord, the factory now builds the Acura ILX, NSX, and TLX.

In 1978, Volkswagen became the first foreign auto manufacturer to build cars within our borders. The German assembly plant, a converted Chrysler factory in Westmoreland, Pennsylvania, closed after a decade due to slow sales. But where VW failed, others succeeded. In 1979, Honda opened its Marysville, Ohio, manufacturing campus and began producing motorcycles. Largely in response to the U.S. government limiting Japanese-car imports in 1981, Honda started building the Accord there a year later, a move that inspired the 1986 Ron Howard–directed cult classic, *Gung Ho*. Toyota has even used the movie as an example of how not to manage an American workforce. Honda continues to build our favorite mid-sizer in Marysville in addition to a number of Acuras. Plants from Nissan, Toyota, Mitsubishi (since closed), and Subaru soon followed. The Japanese were joined by the Germans in the 1990s and the Koreans in the 2000s. Today, there are 17 so-called transplant factories assembling more than 5.5 million vehicles per year. In 2016, that worked out to 46 percent of the 12,244,567 light-duty cars and trucks made in the U.S.A.

Note: Plant size in illustration reflects production capacity.

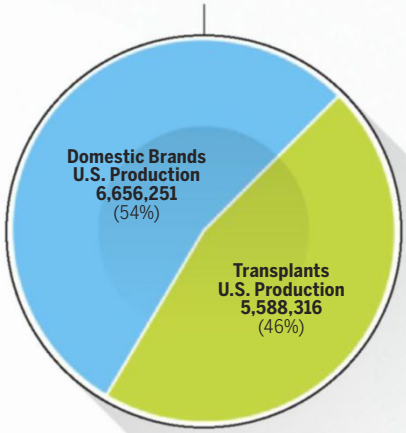
Nissan Canton Vehicle Assembly Plant
Canton, MS
Size: 6.0M sq ft
Models: Nissan Altima, Frontier, Murano, NV, Titan, and Titan XD
First vehicle produced: Nissan Quest, May 2003
Annual production capacity:
450,000

Toyota Motor Manufacturing Mississippi
Blue Springs, MS
Size: 2.0M sq ft
Model: Toyota Corolla
First vehicle produced: Toyota Corolla, Nov 2011
Annual production capacity:
170,000

Toyota Motor Manufacturing Texas
San Antonio, TX
Size: 2.2M sq ft
Models: Toyota Tacoma and Tundra
First vehicle produced: Toyota Tundra, Nov 2006
Annual production capacity:
200,000

Mercedes-Benz U.S. International
Vance, AL
Size: 6.0M sq ft
Models: Mercedes-Benz/-AMG C-class, GLE-class, and GLS-class
First vehicle produced: Mercedes-Benz ML, Feb 1997
Annual production capacity:
300,000

Total U.S. Production
12,244,567

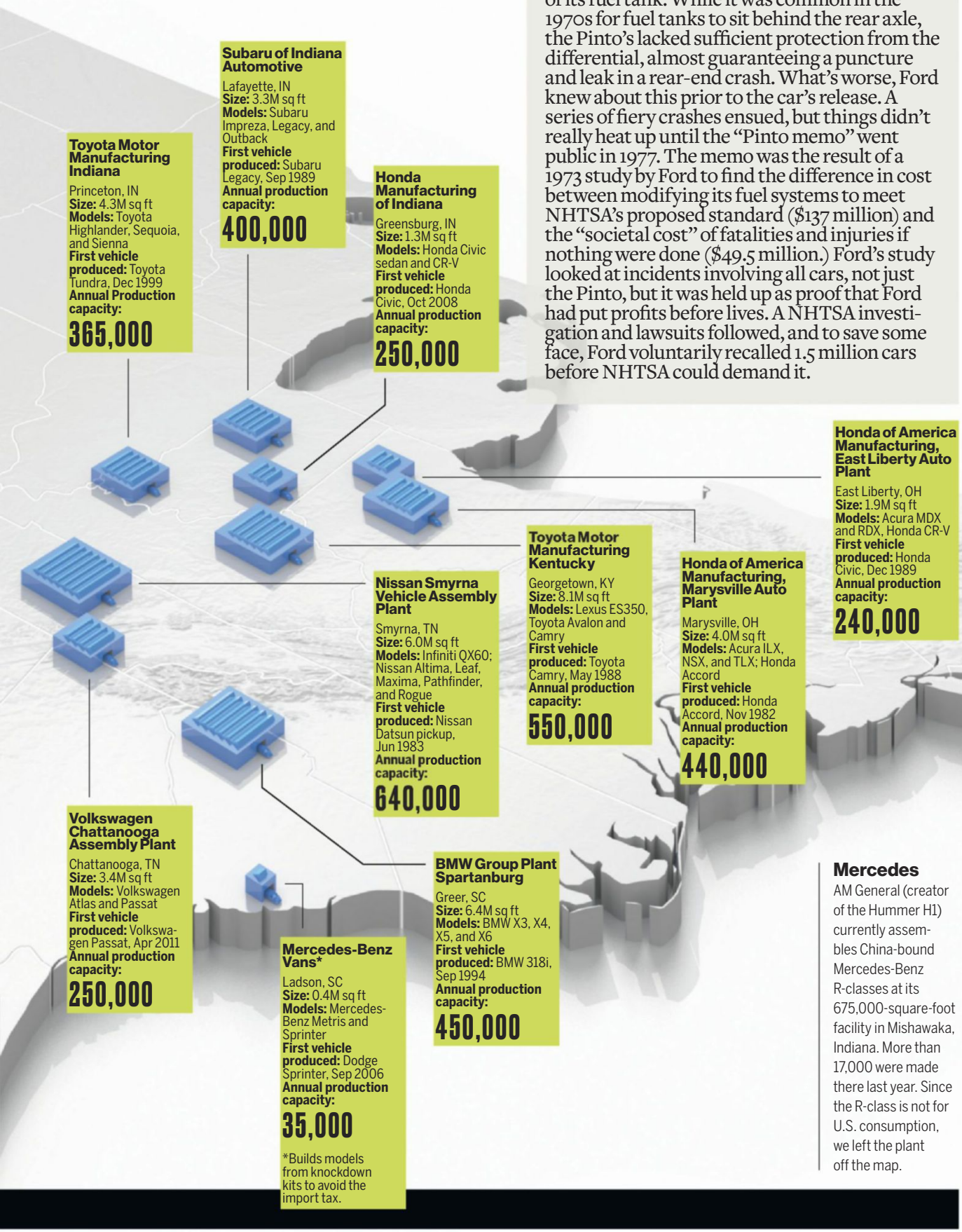


Honda Manufacturing of Alabama
Lincoln, AL
Size: 3.7M sq ft
Models: Acura MDX; Honda Odyssey, Pilot, and Ridgeline
First vehicle produced: Honda Odyssey, Nov 2001
Annual production capacity:
340,000

Hyundai Motor Manufacturing Alabama
Montgomery, AL
Size: 2.0M sq ft
Models: Hyundai Elantra sedan, Santa Fe Sport, and Sonata
First vehicle produced: Hyundai Sonata, May 2005
Annual production capacity:
399,500

Kia Motors Manufacturing Georgia
West Point, GA
Size: 2.2M sq ft
Models: Hyundai Santa Fe, Kia Optima and Sorento
First vehicle produced: Kia Sorento, Nov 2009
Annual production capacity:
360,000

Memo SCANDAL Ford's Pinto probably wouldn't be remembered if it weren't for the placement of its fuel tank. While it was common in the 1970s for fuel tanks to sit behind the rear axle, the Pinto's lacked sufficient protection from the differential, almost guaranteeing a puncture and leak in a rear-end crash. What's worse, Ford knew about this prior to the car's release. A series of fiery crashes ensued, but things didn't really heat up until the "Pinto memo" went public in 1977. The memo was the result of a 1973 study by Ford to find the difference in cost between modifying its fuel systems to meet NHTSA's proposed standard ($137 million) and the "societal cost" of fatalities and injuries if nothing were done ($49.5 million.) Ford's study looked at incidents involving all cars, not just the Pinto, but it was held up as proof that Ford had put profits before lives. A NHTSA investigation and lawsuits followed, and to save some face, Ford voluntarily recalled 1.5 million cars before NHTSA could demand it.



Subaru of Indiana Automotive
Lafayette, IN
Size: 3.3M sq ft
Models: Subaru Impreza, Legacy, and Outback
First vehicle produced: Subaru Legacy, Sep 1989
Annual production capacity:
400,000

Toyota Motor Manufacturing Indiana
Princeton, IN
Size: 4.3M sq ft
Models: Toyota Highlander, Sequoia, and Sienna
First vehicle produced: Toyota Tundra, Dec 1999
Annual Production capacity:
365,000

Honda Manufacturing of Indiana
Greensburg, IN
Size: 1.3M sq ft
Models: Honda Civic sedan and CR-V
First vehicle produced: Honda Civic, Oct 2008
Annual production capacity:
250,000

Honda of America Manufacturing, East Liberty Auto Plant
East Liberty, OH
Size: 1.9M sq ft
Models: Acura MDX and RDX, Honda CR-V
First vehicle produced: Honda Civic, Dec 1989
Annual production capacity:
240,000

Toyota Motor Manufacturing Kentucky
Georgetown, KY
Size: 8.1M sq ft
Models: Lexus ES350, Toyota Avalon and Camry
First vehicle produced: Toyota Camry, May 1988
Annual production capacity:
550,000

Honda of America Manufacturing, Marysville Auto Plant
Marysville, OH
Size: 4.0M sq ft
Models: Acura ILX, NSX, and TLX; Honda Accord
First vehicle produced: Honda Accord, Nov 1982
Annual production capacity:
440,000

Nissan Smyrna Vehicle Assembly Plant
Smyrna, TN
Size: 6.0M sq ft
Models: Infiniti QX60; Nissan Altima, Leaf, Maxima, Pathfinder, and Rogue
First vehicle produced: Nissan Datsun pickup, Jun 1983
Annual production capacity:
640,000

Volkswagen Chattanooga Assembly Plant
Chattanooga, TN
Size: 3.4M sq ft
Models: Volkswagen Atlas and Passat
First vehicle produced: Volkswagen Passat, Apr 2011
Annual production capacity:
250,000

BMW Group Plant Spartanburg
Greer, SC
Size: 6.4M sq ft
Models: BMW X3, X4, X5, and X6
First vehicle produced: BMW 318i, Sep 1994
Annual production capacity:
450,000

Mercedes-Benz Vans*
Ladson, SC
Size: 0.4M sq ft
Models: Mercedes-Benz Metris and Sprinter
First vehicle produced: Dodge Sprinter, Sep 2006
Annual production capacity:
35,000

*Builds models from knockdown kits to avoid the import tax.

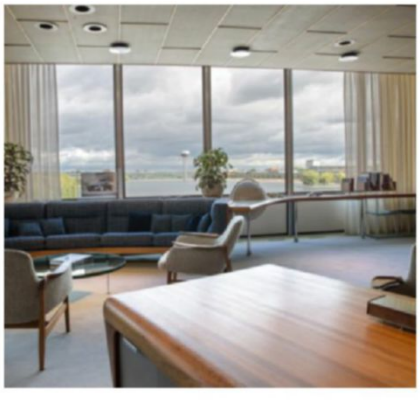
Mercedes
AM General (creator of the Hummer H1) currently assembles China-bound Mercedes-Benz R-classes at its 675,000-square-foot facility in Mishawaka, Indiana. More than 17,000 were made there last year. Since the R-class is not for U.S. consumption, we left the plant off the map.

illustration by BRYAN CHRISTIE DESIGN

Mitchell, Bill

Bill Mitchell was GM's design boss at the height of the company's dominance. His office equaled his style and power. by Jared Gall

Since 1940, General Motors has had only seven vice presidents in charge of design. VP number two, Bill Mitchell, held that title the longest, from December 1958 until his retirement in July 1977—though, to be fair, his predecessor, Harley Earl, headed design for 13 years before the title was instituted and for 18 years after, from 1940 to 1958. Mitchell ushered GM away from the flamboyance of the 1950s, inaugurating a new era of restraint in the '60s and overseeing the dramatic downsizing of the '70s. His reign spanned the height of GM's dominance in the U.S. market and saw his designs realized in some 72.5 million cars and trucks.



All seven of GM's vice presidents of design have occupied the same office at the company's Technical Center in Warren, Michigan, though it was Mitchell who was there the longest. The 710-acre Tech Center campus was designed by midcentury modernist Eero Saarinen with input from Harley Earl. As Michael Simcoe, VP number seven and the office's current occupant, puts it, "This is proper midcentury, done by the guy who put it on the map." The building and the offices in it are largely unchanged—in many cases, right down to the furniture.

According to Simcoe, the only things that are different in the office are "the things you plonk on top." The knickknacks on the counters and desk surfaces, he means.

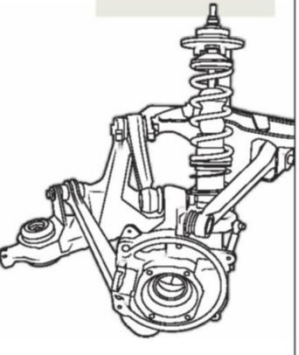
Simcoe compares the view out to that enjoyed by the captain on the bridge of a battleship.

Saarinen's design themes repeat throughout the building, but nowhere are they as strong as in the VP's office, a reminder that everybody's on the same team, but only one person is in charge.

photography by JIM FETS

Movies
In no particular order, our favorite movies judged not by plot or acting chops, but by the starring cars: *The Cannonball Run* [see "C"], *Smokey and the Bandit, Bullitt, Ronin, Cars,* and *Baby Driver.*

Miss Cancellation
Why do we keep running this photo every chance we get?

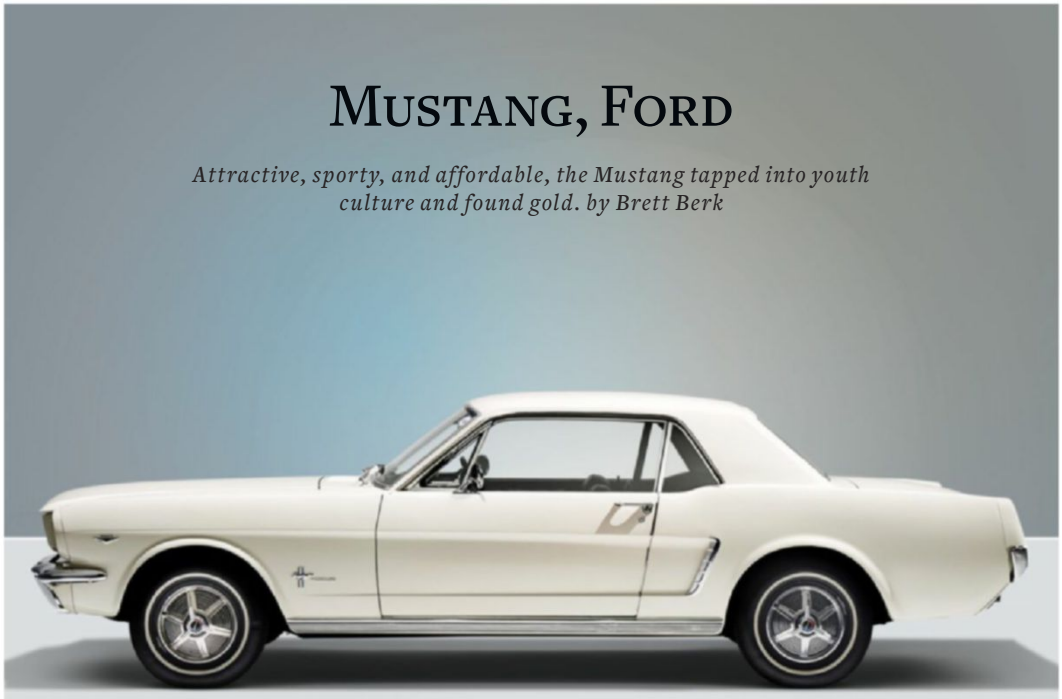


Multilink
A suspension type that consists of at least four separate links, or arms, and no struts. The advantage of a multilink suspension is that each link locates the wheel in a particular way, offering more control over wheel movement than any other conventional suspension layout, benefiting both ride and handling.

MULTILINK ILLUSTRATION BY CHRIS PHILPOT

Mustang, Ford

Attractive, sporty, and affordable, the Mustang tapped into youth culture and found gold. by Brett Berk



Fresh off the Edsel catastrophe, which cost Ford $200 million and earned it a nameplate that would take one of the company's heroes and make him synonymous with failure, Ford's leadership was dubious of any big product launch. So when Lee Iacocca, then vice president and general manager of the Ford Division, approached Henry Ford II with his idea for a novel youth-oriented vehicle, the Deuce was suspicious.

One look at the data should have been enough to convince him. In 1964, the year this new car, the Mustang, was released, there were 72.5 million Americans in the baby boomer cohort. By the following year, people under the age of 20 made up 40 percent of the U.S. population and the median inflation-adjusted household income had increased by more than 60 percent since 1947. In the five years before the Mustang arrived, 14 affordable "compact" vehicles had been successfully launched, and the category was continuing to gain steam. The country was affluent, suburbanizing, young, and desperate for cheap wheels.

"Unlike some of us who grew up in the Depression and regarded automobiles, appliances, and other durables as luxuries," Iacocca said at the Mustang's launch, "these young people look on them as necessities."

Iacocca won approval but had to make do with a constrained development budget. Given this impediment, his genius was threefold. First, Ford built the Mustang almost entirely off the bones of the compact and inexpensive Falcon. Designers gave it distinctive and youthful styling, moving the passenger compartment back to provide sporty, but not overly aggressive, long-hood/short-deck proportions, while still incorporating a practical back seat and trunk to make it usable for families.

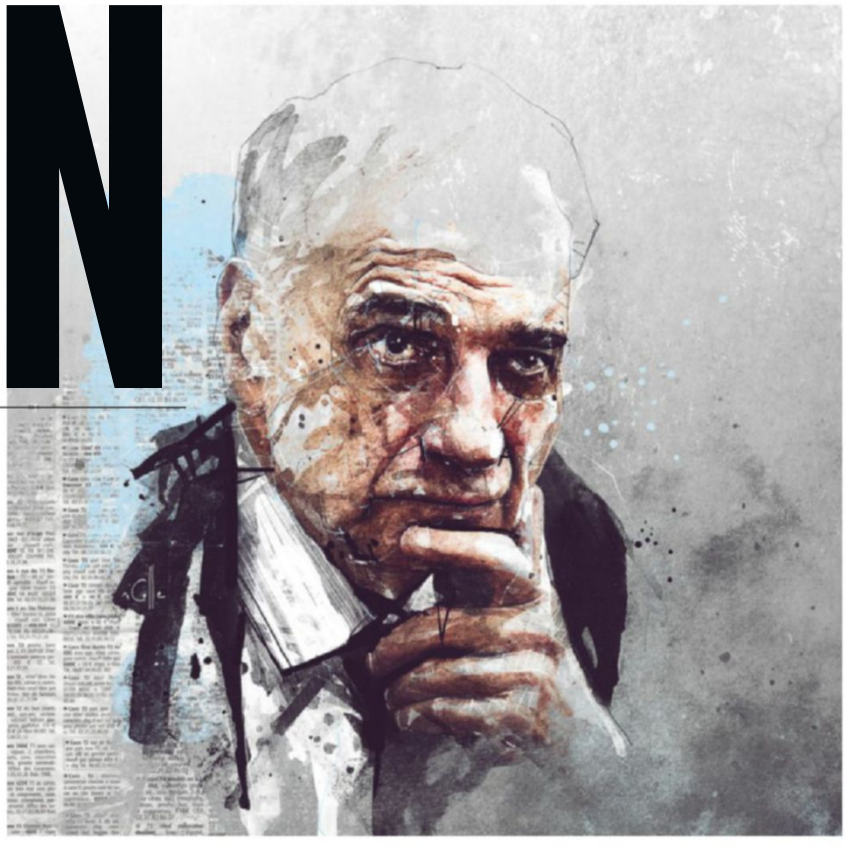
Second, his team designed the car to be cheap to get into—under $2500 and affordable to the youth market. They made the Mustang eminently customizable, too, with a huge range of style, convenience, and performance options. This provided the nameplate the flexibility to be economical, luxurious, and/or sporty—à la carte individualization was the real profit center for the Mustang.

Finally, Iacocca promoted the hell out of it. The car launched midyear at the 1964 New York World's Fair, a setting that provided massive free publicity at a time of year that guaranteed a lack of competition from other models, which were generally released in the fall. Mustang ads blanketed newspapers. His PR guru, Walter Murphy, managed to get the car on the covers of *Time* and *Newsweek* and to air Mustang commercials on all three broadcast TV networks during the same half-hour primetime slot.

It worked. Ford expected to sell 100,000 Mustangs the first year. It sold 22,000 the first day. By the end of 12 months on sale, 417,000 ponies had galloped off Ford dealers' lots.

"A high school youngster from Louisiana promised to start a Mustang fan club," Iacocca said in his speech at the car's unveiling. "He wrote: 'It's better than Elvis or the Beatles.'"

With the Mustang, Ford was the first carmaker to consciously target and successfully tap into youth culture, a well that the advertising world hasn't stopped exploiting since.



Nader, Ralph

We revisit our long-standing animosity toward Mr. Sanctimonious. by Brett Berk

Car enthusiasts rightly demonize Ralph Nader for his role in the death of the Chevy Corvair, a sporty, rear-engined, air-cooled, space-age compact. But while we can't forgive Nader for helping bring us infuriating automatic seatbelts and for sounding sanctimonious and brash, we must reluctantly give props where props are due. Seen against the backdrop of history, his campaign against the Corvair catalyzed modern American consumer protection.

Nader's first book, *Unsafe at Any Speed*, shined a light on some dangerous negligence that the auto industry had engaged in for decades, without meaningful oversight, maximizing profits at the expense of consumer welfare. His exposé led directly to the enactment of foundational automobile impact, safety, and passenger-protection regulations, along with the creation of the National Traffic and Motor Safety Act.

His triumphs led him and his team of young "Nader's Raiders"—and the slew of extragovernmental not-for-profits they spawned—to a radical reevaluation of the idea of health and safety rights. Is there occasional overreach in this area now? Sure. But don't you like not dying when you crash into a bush?

Do you also like not dying when you drink tap water, breathe air, operate machinery at your job, or plug in your toaster? Do you like having recourse against predatory banks, universities, insurance agencies, drug companies, and electrical and telecommunications utilities? Do you like being able to petition the government for transparency and accountability in its activities? Nader had a part in all of that.

His tireless (and often tiresome) efforts in the service of the public interest helped lead to the establishment of laws creating, codifying, and funding the Safe Drinking Water Act, the Environmental Protection Agency, the Consumer Product Safety Commission, the Occupational Safety and Health Administration, and the Freedom of Information Act, among others.

So feel free to love the Corvair as much as you want. But unless you long for the days of lead poisoning, black lung disease, and chest-impaling steering columns, try not to hate Nader too much.

Nürburgring

by John Pearley Huffman

Germany's Nürburgring circuit is archaic, narrow, and surrounded by unforgiving trees. The Nordschleife (or "North Loop") snakes through the Eifel mountains and is long enough, at 12.9 miles, that sunny weather on one part of the course doesn't mean it isn't snowing somewhere else on the track.

Cenek Junek, a 34-year-old Czech banker with some talent and racing dreams, crashed his Bugatti Type 35B during the 1928 German Grand Prix, becoming the first driver to die there. Dozens have since met the same fate during races, testing, and public days. Niki Lauda was virtually incinerated during the 1976 German Grand Prix partly because rescue personnel needed so much time to reach his Ferrari 312T2 as it burned at Bergwerk, a corner halfway around the track. After that, Formula 1 would never return to the place Jackie Stewart dubbed the "Green Hell."

Now, 90 years after its 1927 opening, the Nordschleife has become the most prominent vehicle-development test track on earth. Lap times on it are the de facto standards by which every serious sports, performance, and exotic car is judged.

The core of what has revived the Nordschleife is the establishment of the Industry Pool, which brings together carmakers and suppliers from around the world to co-rent the track for 16 weeks of the year to develop and tune new products. During Industry Pool weeks, there can be a dozen or more manufacturers testing prototypes on the Nordschleife, tweaking their products' handling and guaranteeing YouTube stardom.

The engineers and drivers who use the Nordschleife to develop their vehicles tell us what makes the track special:

■ ***Mark Stielow, engineering group manager of vehicle dynamics, General Motors:*** Most projects get two trips to the 'Ring. There's one fairly early in the development cycle. We call it an IVer phase—integration and verification phase. Then later on, it depends on when the vehicle is launching and when SORP [start of regular production] is, and when different milestones are. An early look-see and a final time to put the final touches on the car.

■ ***Ted Klaus, NSX lead engineer, Honda R&D Americas:*** Driving that course is breathtaking. It's one of those acid tests, like many courses,

illustration by FLORIAN NICOLLE

perhaps the biggest mental acid test I've ever had in my life. Even a driver that's pretty comfortable pushing a car hard has his or her brain screaming at them that what you're doing and what you're seeing is incongruous with the speed combined with the lateral g's. Imagine using that environment to make the man/machine connection more trustworthy.

■ ***Kevin Zelenka, senior ride and handling engineer, General Motors:*** That's the beauty of the Nürburgring. It's 12.9 miles around, and because of the configuration of the track—the elevation changes, the tight turns, and the long straightaways—you can look at everything.

■ ***Matt Becker, chief of vehicle attribute engineering, Aston Martin:*** There is a gentlemen's agreement that you go out on-track whenever you want throughout the day and just get on and do your testing. We never look at or study other Industry Pool vehicles, as we all respect each other's confidentiality.

■ ***Nick Robinson, vehicle dynamics engineer, Honda R&D Americas:*** We'll probably spend 75 or 80 percent of our time on the roads and autobahns around there. And then check that work on the Nordschleife. And so will the other manufacturers.

■ ***Stielow (GM):*** There are certain manufacturers and certain drivers that, over time, you recognize and learn you can trust. They'll keep their line, and you can run a little bit more of a racing line with them. There are other manufacturers that I'll give a wider berth.

■ ***Robinson (H):*** I can't say I'm on a first-name basis with a lot of the other drivers there. But over the years, you visually get to know people. There's a lot of professional respect for making clean passes. And there are only so many places to eat dinner.

■ ***Bill Wise, Camaro performance engineer, General Motors:*** It kind of fell to me to drive [the ZL1 1LE] by default. I don't want to say that like it's a bad thing. It was a mixture of comfort level in the car and maybe a little bit of a reward for a year and a half of work. That's the fastest lap we have video of, but it's not the fastest lap we ran while we were there. I did a 7:15 from a dead stop. If we take out the dead stop, which is about two and a half to three seconds, on the last day, we essentially ran a 7:13. But that was during [Industry] Pool, so we weren't allowed to run video. We posted the fastest one we can back up with video.

■ ***Becker (AM):*** We wouldn't compromise the feel or behavior of an Aston Martin product to achieve a lap time. Lap times are important, especially on the sports cars more than the GTs, but we don't chase the numbers. But we want to be competitive in the relevant segment.

■ ***Stielow (GM):*** Normally, we use the ride and handling engineer [to extract the fast lap]. They've been with that property since day one, and they know more about that vehicle than anyone else on the face of the planet. You're not going to be a level-six Nürburgring driver [GM's top driving level reserved for engineers who set lap times] if you're not a little bit aggressive.

■ ***Robinson (H):*** I really like to share that place with some of the younger engineers that we have here. Those first couple of laps to show the course to someone who grew up playing Forza or Gran Turismo to get a feel for the course, it's still jaw-dropping for those guys. To actually be there and see the elevation change, the narrowness of the course—there are so many blind sections where you're holding the throttle open. It's kind of a sensory overload, as you're just starting to understand the course.

■ ***Wise (GM):*** You have some moments where you kind of pucker and go, "Oh crap, that wasn't good." But there were no times for me when I was afraid of anything. When we're doing development, I definitely have the engineer hat on, and I'm looking at the car analytically. But when you do a fast lap, it's like flipping a switch from development side to racing side. It's a track that rewards taking risks. So there comes a time when you get yourself into a situation you may not be comfortable with, just to see what the car will do. And then, on a lot of occasions, the car will stick.

■ ***Becker (AM):*** The circuit is incredibly useful for highlighting any stability issues.

■ ***Robinson (H):*** The unique thing about the 'Ring is that the road, in certain places, violently tries to throw your car away from the road right where you need to stay attached to the road.

■ ***Wise (GM):*** The vertical changes are so severe and so abrupt that you need the right damping levels to control those body motions and get the most out of it. We've got two functions: Flying Car PTM [Performance Traction Management, a stability-control algorithm that recognizes the vehicle is airborne and keeps the electronics from freaking out despite the complete lack of traction] and Flying Car ABS. In most of those scenarios, when the vehicle is airborne, it sees massive wheelslip and brings in a big torque reduction. So it's really slow when it lands. We basically time it out so it doesn't do that. And it's the same on the ABS side.

■ ***Zelenka (GM):*** Flying-car algorithms. That specifically came from pucker moments at the Nürburgring where, "Oh shit, we've got to do something to fix this [when the electronics improperly respond to all the wheels leaving the ground by cutting power or applying the brakes]."

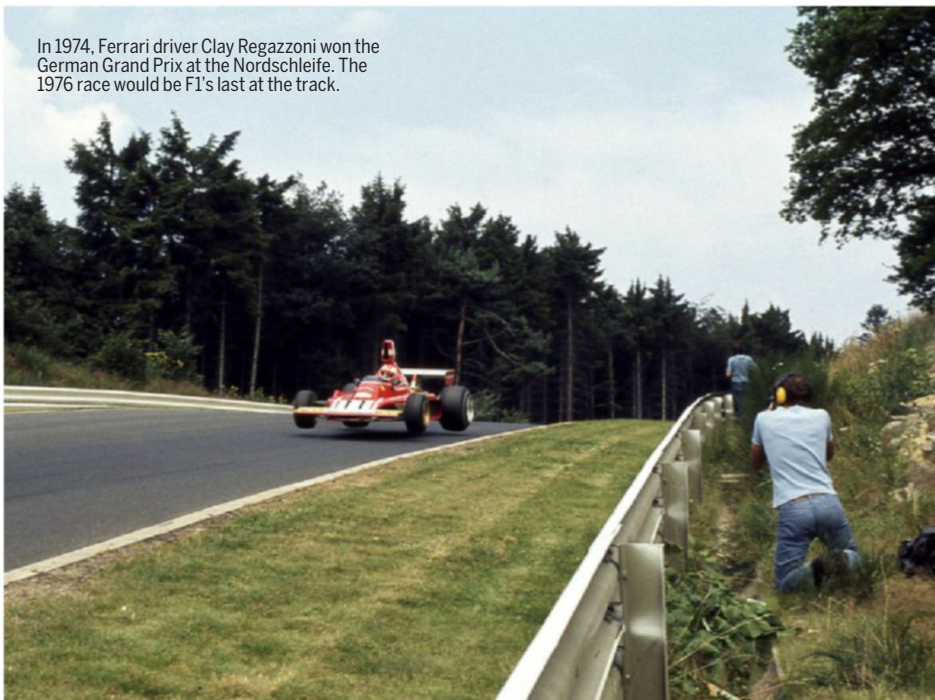
■ ***Klaus (H):*** The active-damper-system logic originally introduced on the '07 MDX was significantly modified by the challenges of the 'Ring.

■ ***Zelenka (GM):*** One of the difficulties with the track is that, if you find something in a specific corner, like you lose steering assist at the bottom of Fuchsröhre and you make a calibration change, it's at least eight minutes around before you can take a look at that [calibration] change again.

■ ***Robinson (H):*** We did one of our big powertrain trips for two weeks. We had maybe 20 guys. Other times, we're down to 12 or so.

■ ***Zelenka (GM):*** We've had as many as 24 to 25 engineers and supplier engineers [at the 'Ring] when we sent Cadillac, Camaro, and Corvette out there. When the execu-types show up, it's up to 36 people. If we're strictly going there to do a fast lap, it's fewer people. Our teams generally prefer [to stay at] the family-owned places. They treat us like family. And pack us lunches. They email me Christmas cards.

■ ***Klaus (H):*** One of the first times we went there, we stayed at a hotel in Müllenbach, and for breakfast, each table was set up with a little flag. Either the [manufacturer's] national flag or Volkswagen, Audi, Porsche [brand flags] . . . and we came down, and there was a little Honda flag. It was pretty cool.



In 1974, Ferrari driver Clay Regazzoni won the German Grand Prix at the Nordschleife. The 1976 race would be F1's last at the track.

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O

OBD-II
Mandatory on all new light-duty vehicles sold in the U.S. since 1996, OBD-II, or On-Board Diagnostic II, is a standardized coding and problem-sniffing system that monitors a number of emissions- and engine-related components, simplifying diagnosis and repair. It uses a common 16-pin scan tool to read the codes.

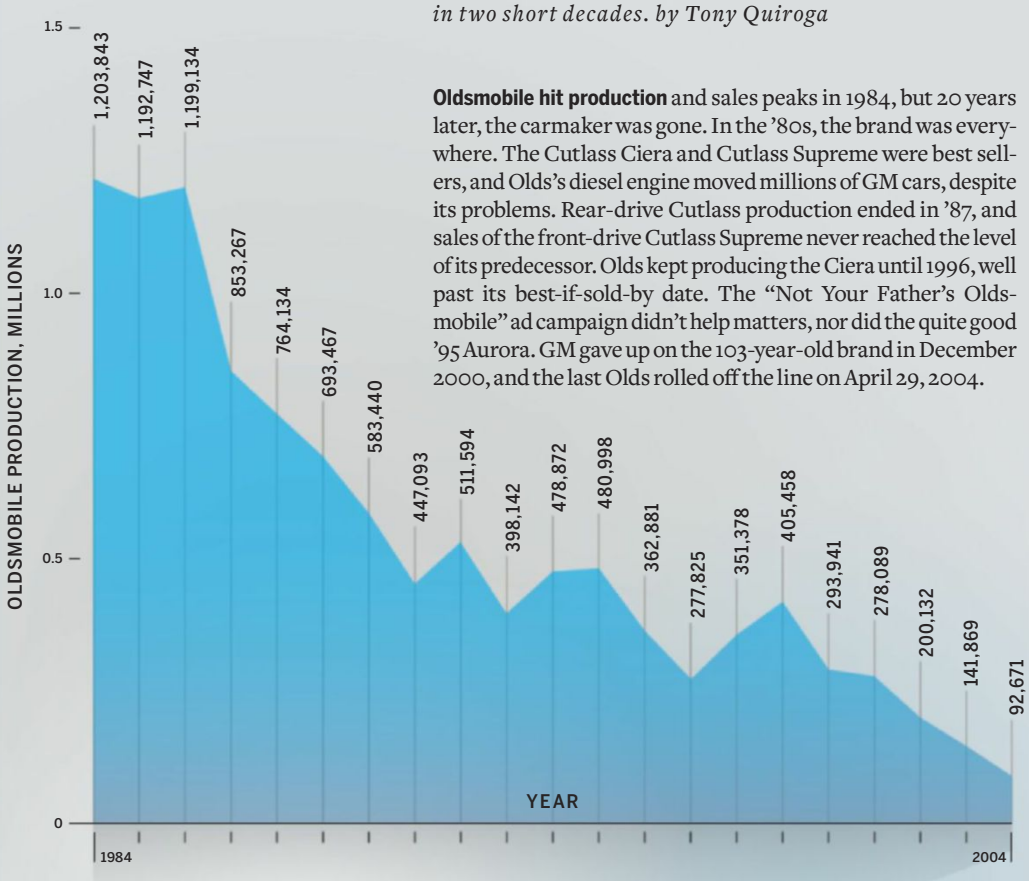
Oddity
See "Aztek," "Yugo," and "Zimmer."

Odyssey
A Honda minivan [see "Marysville, Ohio"]. Also an epic poem about a Greek man who gets sidetracked on his way home from the Trojan War.

Oldsmobile

GM's oldest brand went from sales dominance to death in two short decades. by Tony Quiroga

Oldsmobile hit production and sales peaks in 1984, but 20 years later, the carmaker was gone. In the '80s, the brand was everywhere. The Cutlass Ciera and Cutlass Supreme were best sellers, and Olds's diesel engine moved millions of GM cars, despite its problems. Rear-drive Cutlass production ended in '87, and sales of the front-drive Cutlass Supreme never reached the level of its predecessor. Olds kept producing the Ciera until 1996, well past its best-if-sold-by date. The "Not Your Father's Oldsmobile" ad campaign didn't help matters, nor did the quite good '95 Aurora. GM gave up on the 103-year-old brand in December 2000, and the last Olds rolled off the line on April 29, 2004.



Oldsmobile never had a worthy follow-up to the rear-drive 1987 Cutlass Supreme (shown). →

Oversteer The engineering term for when the back of the car hits the wall before the front does. Also, when the slip angle of the rear tires exceeds that of the front, sending the tail drifting wide.

photograph by JOHN ROE

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Pickup Trucks

Satirist and prolific author P.J. O'Rourke revisits the back porch with an engine.

Thirty-five years ago, occasional *C/D* contributor P.J. O'Rourke penned an essay titled "High-Speed Performance Characteristics of Pickup Trucks." O'Rourke, inspired by an early-'80s surge in pickup-truck popularity, closely examined the phenomenon and wrote: "A pickup truck is basically a back porch with an engine attached. Both a pickup and a back porch are good places to drink beer because you can take a leak from either one standing up." In the intervening decades, pickups have become even more popular. So we asked O'Rourke to check in on the state of the once humble pickup truck. Here's what he sent in:

Pickup trucks have died and gone to heaven. The unwashed and battered farm, ranch, and loading-dock fetch-and-carry is a celestial being now.

The prices certainly are sky-high. A 2018 Ford Super Duty F-450 Limited Crew Cab dualie runs $87,100. In 1955, when *Car and Driver* was founded (as *Sports Cars Illustrated*), the most you would pay for a Ford pickup truck—a stake-bed F-350—was $1824 (which is equivalent to $16,660 in today's dollars).

Dealers are in paradise, too. The three most popular vehicles in America are the Ford F-series, Chevrolet Silverado, and Ram pickups. Together, they outsell the fourth-place Toyota Camry, an actual car, by almost five to one.

Today's pickups have interiors that make the inside of a Bentley look like a $35 motel room. They have four doors. They are commodious enough for your yoga class, even if the namaste makers want to turn the climate control up to global-warming panic and practice Bikram inside the truck.

But there's nothing effete about these pickups. Their styling is aggressive enough to make Peterbilts hide behind interstate weigh stations. So is their size. Move your family into the three-car garage; you'll need the McMansion for the truck. And you'll need airline-passenger boarding stairs to reach the pickup's doorsill.

Angels from on high, pickups are Dominions, Virtues, and Powers. Power especially—the Ford F-150 Raptor has 450 horsepower. Pickup trucks replaced farm horses beginning with the 1917 Model T roadster pickup. Imagine going to town in an unsprung "Democrat wagon" pulled by 450 horses.

But so nimble and quick is the modern pickup that NASCAR has a Truck Series. Too bad it wasn't founded until 1995. How wonderful it would have been to see the pickups of yore on a racetrack with feed and grain and bales of hay blowing over their tailgates and spectators covered in timothy and alfalfa.

Just one part of the pickup didn't go to heaven. The cargo bed went to hell. It's an afterthought these days, a tea tray on a Cowboy Cadillac trunklid.

You can't put a pair of happy black Labs back there, ears flapping in the wind. There's barely room for a Shih Tzu. And Shih Tzus are lousy at retrieving ducks.

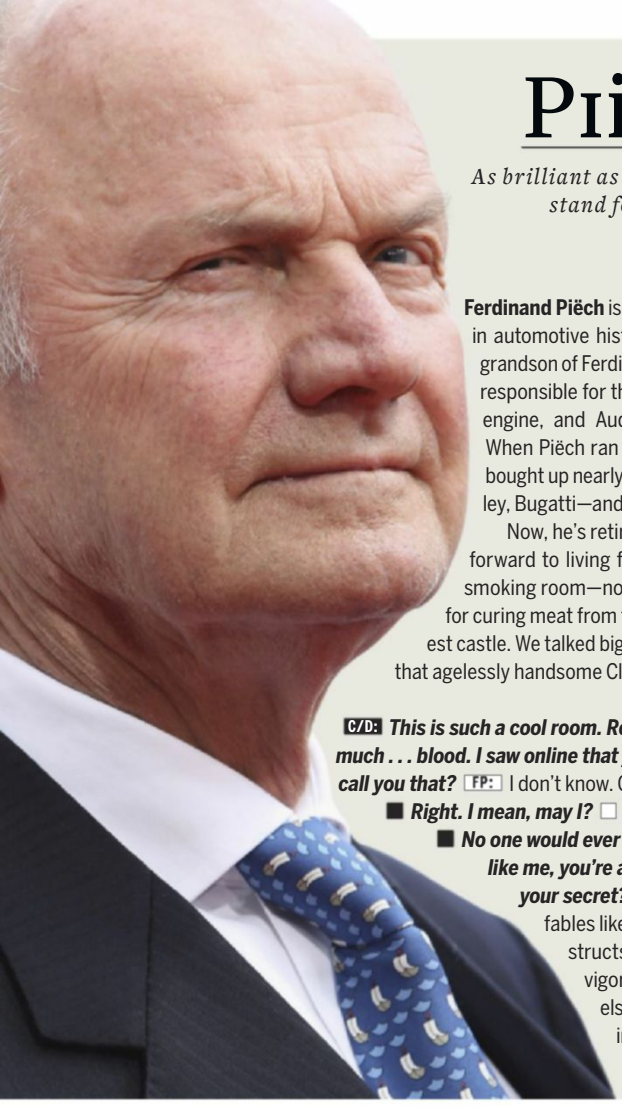
How do you haul a busted refrigerator to the dump? Where's the loam for the yard your dogs dug up go? How do you carry a load of gravel for the driveway you wouldn't drive on in your Super Duty F-450 Limited for fear of stone chips?

Come back to life, pickup trucks. You used to have an earthly purpose.

illustration by VIN GANAPATHY

Piëch, Ferdinand

As brilliant as he is scary, Germany's prototypical auto executive would never stand for our questions, so we had to get creative. by Brett Berk



Ferdinand Piëch is one of the most important executives in automotive history, and not just because he is the grandson of Ferdinand Porsche. He is the man primarily responsible for the Porsche 917, the Audi five-cylinder engine, and Audi's Quattro all-wheel-drive system. When Piëch ran the family business, Volkswagen, he bought up nearly every hot brand—Lamborghini, Bentley, Bugatti—and made Audi, well, Audi.

Now, he's retired, and like all dæmons, he's looking forward to living forever. We hung out with him in his smoking room—not the kind you're thinking of, the kind for curing meat from the hogs he butchers at his Black Forest castle. We talked big ups, letdowns, and how he maintains that agelessly handsome Claus von Bülow–meets–Skeletor look.

C/D: ***This is such a cool room. Reminds me of Suge Knight's. So much . . . blood. I saw online that your friends call you Burli. Can I call you that?*** **FP:** I don't know. Can you?

■ ***Right. I mean, may I?*** ☐ No. Quite obviously, no.

■ ***No one would ever guess that you're 80 now—and, like me, you're an Aries! You look amazing. What's your secret?*** ☐ I place no faith in imbecilic fables like astrology, God, or any of the constructs of man. As for how I remain vigorous, I suppose it is just like anyone else, inhaling the fear of the weak and injecting intravenously the distilled life force of those I vanquish.

■ ***Distilled life force? LOL. Is that available at Sephora?*** ☐ [*Makes teeth sucking noise.*]

■ ***There's been a lot of infighting in your family and business. What keeps you focused? Meditation? Pure Barre? Yoga?*** ☐ Yo-ga? Uch. This requires too much silly breathing. [*Pantomimes silly breathing.*] What am I, a nanny in labor? [*Stares icily.*]

■ ***Speaking of women, so many car companies, and countries, seem to be run by women these days.*** ☐ That is not a question. It is barely an observation. Write this on your hand, dummkopf: *Der überlegene Mensch wird immer triumphieren.*

■ ***Katy or Gaga?*** ☐ Gaga, definitely. She has range and class, and a unique aural quality—like a 917's flat-12 or an ur-Quattro five-cylinder at full chat. Katy is a frivolous *Miststück*. Although I did enjoy that she outflanked those nuns to purchase and transform a convent into her dream house in Los Angeles. I once watched a film about an Austrian nun; they are worthy adversaries.

■ ***Do you have any advice for our readers getting started in the car business today?*** ☐ Be born into the right family and disregard entirely the humanity of others. Now, please leave. My *Schwein* is nearly ready.

PIËCH PHOTOGRAPH BY SEAN GALLUP/GETTY IMAGES. 911 PHOTOGRAPH BY JAMES LIPMAN

Porsche 911 The quintessential, and now only, ass-engined sports car. The 911 celebrated its 50th anniversary in 2013 and hit 1 million sales earlier this year. Although a new 911 shares little with the original, the connection is undeniable.

PRNDL

SCANDAL In the early '70s, Ford received complaints from a handful of owners that the gear selector—a.k.a. PRNDL—in its automatic-equipped cars had a tendency to slip from park to reverse. Ford looked into it and concluded that the fault lay with the driver for not fully engaging park. While this problem was not exclusive to Fords, NHTSA found that it was 12 to 14 times more likely to happen in a Ford than in a Chrysler or GM car and reported in 1978 that the supposed defect had led to more than 750 accidents, 250 injuries, and 20 deaths. Instead of recalling nearly 23 million cars, NHTSA came to an agreement with Ford: The carmaker would send out warning labels to owners with instructions on how to properly park their cars.

QR

Q, The Letter

by Jared Gall

The key to a good alphanumeric vehicle-naming scheme is to have established yours early. By 1989, when Nissan launched its upscale Infiniti brand, the alphabet was looking like gold-rush California circa 1855, with all the best claims already staked. Infiniti didn't choose Q for its first flagship because the letter is half of IQ, or because it's in smart-sounding words such as inquisitive or loquacious or Quiroga; it chose the letter because, well, all the good letters were already taken by other luxury brands.

"Embracing the scraps" isn't a terribly punchy marketing scheme, though Infiniti's official line was hardly better. According to releases of the day, Infiniti's luxury sedan, the Q45, was so named because Q "lies in the high end of the alphabet and represents a high-end luxury automobile." If only Infiniti knew someone with a Z lying around . . .

When Audi launched its first SUV in 2006, it had a better reason for naming it Q7: Quattro was what the brand had been calling its all-wheel drive for 26 years. Q was convenient shorthand. Still, Infiniti's parent company filed a lawsuit attempting to bar Audi from using the letter. The two came to an agreement, though, and Audi stayed quiet when Infiniti decreed at the end of 2012 that it was going to apply the Q naming convention across its entire model line. Recently, Audi announced an overhaul of its naming scheme, adding additional numbers denoting engine power to its model designations, a decision that promises names as perplexing as Infiniti's. We wouldn't be surprised if Infiniti's lawyers were psyching themselves up—blasting *Jock Jams* and struggling with those stubborn bottom buttons on their tear-away three-piece pinstripes—as they prepare another suit against Audi to make sure confusing Q-based names remain the exclusive intellectual property of Infiniti.

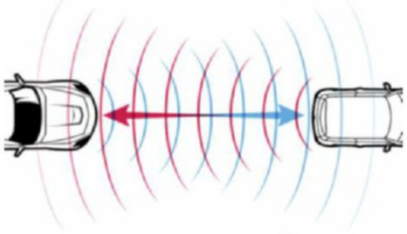
Quality
See "Japan."

Radar

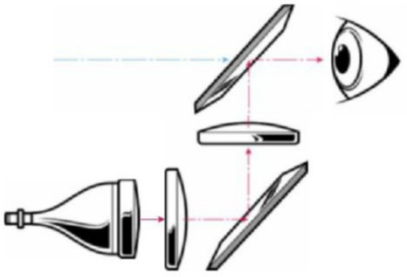
Military technology without all the rules. by K.C. Colwell

Radio detection and ranging, or radar, is said to be one of the key factors that turned the Battle of Britain in favor of the Allies. Without it, the German *Luftwaffe* likely would have pounded the island so hard that Hitler's planned ground attack might have been possible. But radar didn't just shift the tides of war, it quickly changed how we live. Radar-based air-traffic control began postwar and changed how we travel. Weather radar, which was stumbled upon by World War II radar operators, changed how we plan our schedules and prepare for coming weeks. Police radar devices, which use Doppler radar to measure the speed of a moving object and were developed in the 1940s, changed how we drive and also generated municipal income. Those gave rise to the radar-detector industry in the '60s, producing such fantastic trade names as Bearfinder, Super Snooper, Smokey Patrol, and Fuzzbuster. But radar isn't the only military technology to leave its imprint on the automotive world. Here are three military-derived technologies and how they work:

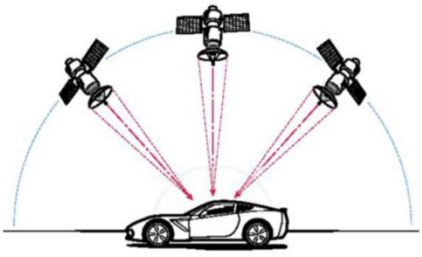
Radar: Send high-frequency electromagnetic radio waves into the air, and those waves will bounce off objects. Use a radio receiver to collect the waves, and the distance and speed of an object can be easily determined. Today's cars use radar for active cruise control, collision-warning systems, blind-spot monitoring, and some mild automation. Ultrasonic sensors, such as those embedded in bumpers, detect close-range objects and work on a similar principle but use sound waves instead of radio.



Head-Up Display: The success of military fighter jets often hinges on the ability of pilots to make quick decisions; head-up displays were born out of pilots' need to keep critical information in view at all times. Their eyes must focus on objects of varying distances, and glancing down at a cluster of gauges requires a split second that could mean the difference between life and death. Automotive HUDs work by projecting an image onto the treated surface of a car's windshield (or a separate collimator panel, as in a fighter plane or a Mazda 3). To the driver, the displayed information appears parallax-free, or always in focus, thus preventing eye strain. GM was the first to put a HUD into a car, way back in 1988.



Global Positioning System: The U.S. Global Positioning System relies on a network of at least 24 satellites orbiting the earth at an altitude of 12,550 miles; they transmit their location in radio waves to a ground receiver. The receiver then calculates its relative position by way of trilateration. After a Korean Air 747 flew off course and was shot down by the Soviets in 1983, President Reagan issued a directive allowing civilian use of the GPS. But it wasn't until President Clinton issued a policy in 2000 to unscramble civilian GPS signals, making them as precise as the military's, that in-car navigation systems took off. If you doubt that the GPS has changed the automobile, think about the last time you pulled a road map from the glovebox.



Radial Developed in the late 1940s by Michelin, the radial tire gained mainstream acceptance in the 1970s. A radial tire differs from a bias-ply one in that the numerous belts below its rubber tread run perpendicular to the tread's centerline. To strengthen the tire, a set of stiff belts (usually made of steel or synthetic fibers such as Kevlar) runs in the same direction as the tread. The advantages of the radial over the bias-ply tire include greater compliance, less rolling resistance, longer life, and often better drivability.

RADAR ILLUSTRATIONS BY CLINT FORD. TIRE ILLUSTRATION BY PETE SUCHESKI

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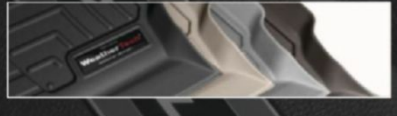

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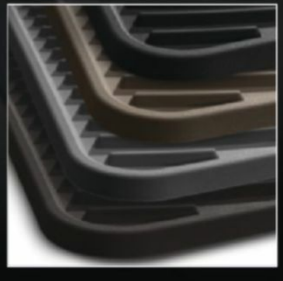

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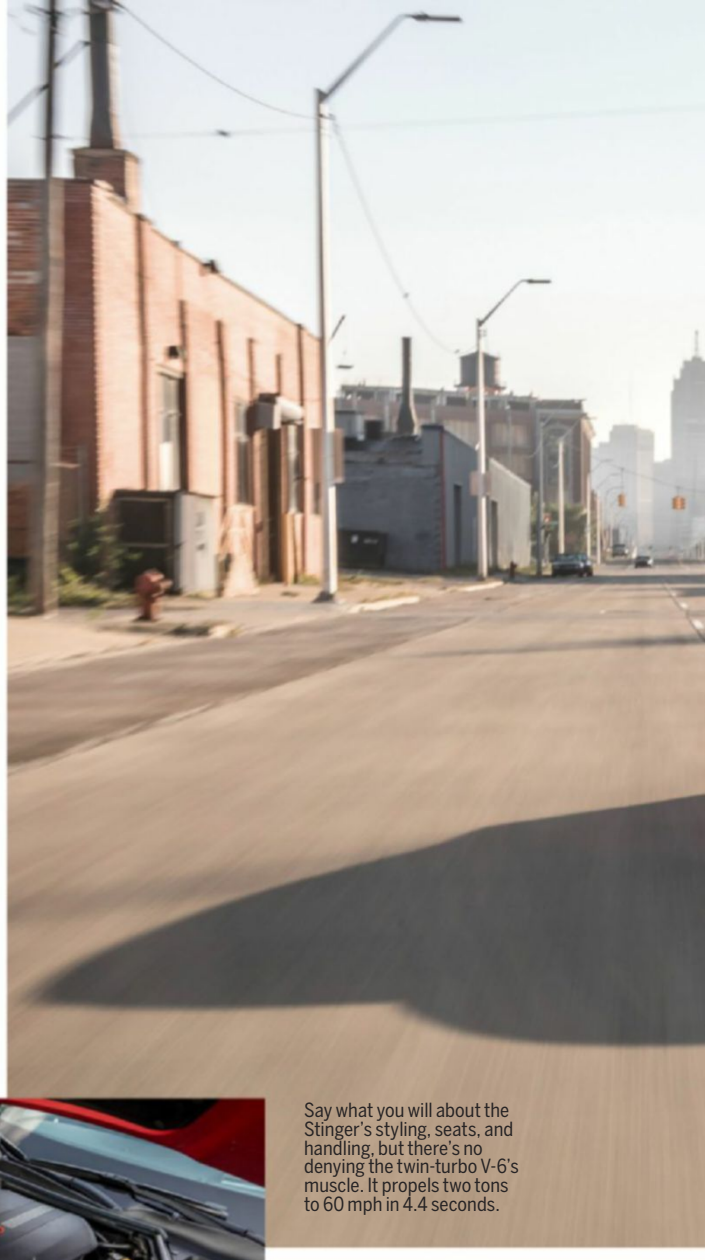
Road Test: Kia Stinger

The road test is C/D's most thorough vehicle evaluation. For our 750th issue, we delve into Kia's powerful new rear-driver to see if it delivers on its sporty promise.

by Josh Jacquot

photography by Marc Urbano

↑ 2018 Kia Stinger GT



Say what you will about the Stinger's styling, seats, and handling, but there's no denying the twin-turbo V-6's muscle. It propels two tons to 60 mph in 4.4 seconds.

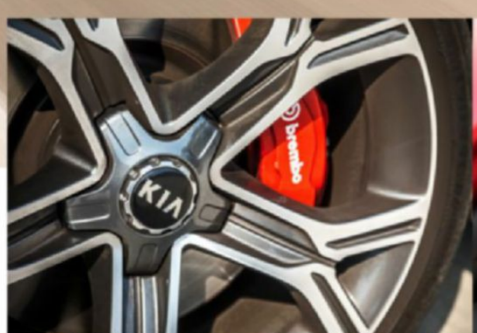
That the Kia Stinger looks as outrageously low and mean as it does is perhaps our highest praise for the new four-door sport hatch. Few and far between are cars that survive the bureaucracy-filled odyssey from show stand to showroom without suffering character-killing dilution. Yet the production Stinger's shape matches nearly line for line that of the Kia GT Concept, which made its debut at the 2011 Frankfurt motor show. Production realities excised the concept's rear-hinged rear doors, added B-pillars, and transformed its wing cameras into conventional door-mounted side mirrors. Otherwise, the similarities are as plain as day. The GT's grille-flanking intake scoops remain on the production car, as do the wraparound taillamps, which terminate in reflectors on the rear quarter-panels. The rear side windows, too, share their distinctive quarter-round shape with the GT Concept's. Even the Stinger's name, which shrouds the car in the same majesty as greats such as the Plymouth Fury and the Hillman Imp, hints that something is different about this Kia. Part of that something—a big part of it, actually—is shocking straight-line performance.

Our test car, a preproduction rear-wheel-drive GT fitted with the brand's 365-hp twin-turbocharged 3.3-liter V-6, treated us to a 12.9-second quarter-mile at 111 mph. And it did so without any fanfare. Just wood the throttle and the car's 255/35ZR-19 Michelin Pilot Sport 4 rear rubber finds the purchase necessary to produce such numbers. The homegrown eight-speed automatic is at its best when left to shift itself, so that's what we did. Its gearchanges, like those of Porsche's PDK-equipped cars, are rapid enough to be invisible on the speed trace plotted by our VBOX test gear, which is to say they're pretty damned fast. The near-optimal grip/power balance yields a 4.4-second zero-to-60 time, which is as quick as or quicker than pretty much everything in the Stinger's wide purview. And though launch control wasn't functional on our early tester, it's unlikely to help a car that takes off like the Stinger does. Perhaps the most striking facet of the engine's power delivery is evident in the Stinger's 5.0-second five-to-60-mph time—quicker than every machine in our last comparison test of mid-size premium sports sedans ["Climb Every Mountain," May 2017]. Acceleration is strong with this one.

Braking, too, is better here than in those sedans from Audi, BMW, Cadillac, Jaguar, and Mercedes, requiring only 156 feet from 70 mph. Four-piston front and two-piston rear Brembo calipers are standard on the GT. Pedal response is predictable, but it's spread over more travel than we'd prefer. The short stopping distance is no doubt aided by a 4004-pound as-tested weight, which is about as light as the cars in this class come.

Kia, of course, has a broader plan for this hatchback, which includes more than just impressive acceleration and braking. It wants to match up to the established German mid-sizers. The base-trim Stinger (without the GT moniker) comes standard with a 255-hp turbocharged 2.0-liter four-cylinder coupled to an eight-speed auto, a popular modern powertrain configuration. Both engines are available with rear- or all-wheel drive. And the Stinger is competitively scaled. Its 114.4-inch wheelbase is only a few tenths of an inch shorter than the Audi A6 and S6's, and its overall length, at 190.2 inches, is about four inches shorter than the A6 and the BMW 5-series sedans'. But both its wheelbase and overall length are greater than those of the BMW 3-series, Cadillac ATS, and Mercedes C-class sedans. Indeed, its interior volume is competitive with that of most mid-size premium players—a fact that was plainly obvious when our largest staffer took the Pepsi Challenge with the Stinger and Audi A5 Sportback rear seats. He actually fit in the Kia.

But it's the handling latitude and capability of cars such as the BMW 4-series Gran Coupe—a car that Kia carefully benchmarked



in its development—that the Stinger targets with the GT's five drive modes (Smart, Eco, Comfort, Sport, and Custom). Shared with the upcoming Genesis G70, the Stinger's platform uses struts up front and a multilink rear suspension. A clutch-type limited-slip differential is standard in top-trim GTs, and the car's dampers continuously adjust within two distinct calibrations that are tied to the drive modes. Custom mode allows drivers to tweak engine and transmission responses, steering effort, damping rates, and engine-sound enhancement, which is accomplished through the Stinger's audio-system speakers.

At 0.93 g, the Stinger's skidpad grip is on par with middleweight sports sedans. But lean aggressively on it through a meandering back road, and the edges of the Hyundai Kia chassis-tuning strategy begin

[+] Holy crap(!) acceleration; mid-size-car space, compact-car money; solid feature count. [–] Rough-edged limit handling, lacks luxury-level finish, on the loud side. [=] Not a luxury car but an awfully quick approximation of one.

to fray. Communication through the electrically assisted steering wheel lacks the granular precision of most any Audi sedan. Press the Stinger on a demanding road, and its acumen diminishes as the limits approach. Midcorner heaves and crests reveal a front/rear damping imbalance that's unnervingly exposed near the ragged edge. Even in their stiffest setting, the rear dampers fail to adequately control the Stinger's rear-end movement, affording its driver the opportunity to experience the suspension's full range of geometry changes during cornering and acceleration. Perceptibly awkward pitch and dive motions accompany acceleration and braking when pushing the car hard.

Then there's the transmission. Wheel-mounted shift paddles deliver rev-matched downshifts, provided the requests aren't overly aggressive. Response to upshift inputs isn't instant, even if the shifts themselves are. And the Stinger, regardless of its drive mode, forcefully resists holding gears at redline unless its stability control is disabled. These are all calibration choices that could change before production. They're also potent details that speak to the Stinger's merely modest commitment to the craft of driving like an insane person.

Kia, for its part, admits that the Stinger's ride prioritizes comfort over ultimate performance, and that's not a bad thing for a self-proclaimed GT car. Avoid the edge of its limits and it will serve you well, doling out a touring-level ride appropriate for its cruise-missile status on the open road. It is indeed comfortable, but it's not the suspended-by-clouds feeling you'll find in its upmarket competition. The GT's seats are soft and wide and covered in nappa leather, but they don't offer striking material quality, supportive bolstering, or stunning beauty. It's a theme that carries throughout the Stinger's interior, which is unobjectionable but a level below the premium sedans whose numbers the Stinger matches in performance testing.

As with most Hyundai and Kia products, the Stinger's infotainment and HVAC

2018 KIA STINGER GT

PRICE
AS TESTED **$50,395***
BASE **$39,895***

VEHICLE TYPE: front-engine, rear-wheel-drive, 5-passenger, 4-door hatchback
OPTION: GT2 trim level, $10,500
AUDIO SYSTEM: satellite radio; minijack, USB, and Bluetooth-audio inputs; Android Auto and Apple CarPlay interfaces; 17 speakers

ENGINE
twin-turbocharged and intercooled V-6, aluminum block and heads
BORE X STROKE ..... 3.62 x 3.30 in, 92.0 x 83.8 mm
DISPLACEMENT ..... 204 cu in, 3342 cc
COMPRESSION RATIO 10.0:1
FUEL DELIVERY SYSTEM: direct injection
TURBOCHARGERS ..... Honeywell MGT1446
MAXIMUM BOOST PRESSURE ..... 17.2 psi
VALVE GEAR: double overhead cams, 4 valves per cylinder, variable intake- and exhaust-valve timing
REDLINE/FUEL CUTOFF ..... 6500/6750 rpm
POWER ..... **365 hp @ 6000 rpm**
TORQUE ..... **376 lb-ft @ 1300 rpm**

DRIVETRAIN
TRANSMISSION: 8-speed automatic with manual shifting mode
FINAL-DRIVE RATIO ..... 3.54:1, clutch-type limited-slip differential

GEAR	RATIO	MPH PER 1000 RPM	MAX SPEED IN GEAR (rpm)
1	3.67	5.8	39 mph (6750)
2	2.40	8.8	59 mph (6750)
3	1.61	13.2	89 mph (6750)
4	1.19	17.8	120 mph (6750)
5	1.00	21.2	143 mph (6750)
6	0.83	25.6	167 mph (6550)
7	0.64	33.2	160 mph (4800)
8	0.56	37.9	155 mph (4100)

CHASSIS
unit construction with a rubber-isolated rear subframe
BODY MATERIAL: steel stampings

STEERING
rack-and-pinion with variable ratio and variable electric power assist
RATIO 13.3–11.3:1
TURNS LOCK-TO-LOCK 2.2
TURNING CIRCLE CURB-TO-CURB ..... 36.9 ft

SUSPENSION
F: ind, strut located by 1 lateral link and 1 diagonal link per side, coil springs, 2-position electronically controlled dampers, anti-roll bar
R: ind; 2 diagonal links, 2 lateral links, and a toe-control link per side; coil springs; 2-position electronically controlled dampers; anti-roll bar

BRAKES
F: 13.8 x 1.2-in vented disc, 4-piston fixed caliper
R: 13.4 x 0.9-in vented disc, 2-piston fixed caliper
STABILITY CONTROL ... fully defeatable, traction off

WHEELS AND TIRES
WHEEL SIZE ..... **F:** 19.0 x 8.0 in **R:** 19.0 x 8.5 in
WHEEL CONSTRUCTION ..... cast aluminum
TIRES: Michelin Pilot Sport 4
F: 225/40ZR-19 (93Y)
R: 255/35ZR-19 (96Y)

EXTERIOR DIMENSIONS
WHEELBASE ..... 114.4 in
LENGTH ..... 190.2 in
WIDTH ..... 73.6 in
HEIGHT ..... 55.1 in
FRONT TRACK ..... 62.8 in
REAR TRACK ..... 63.7 in
GROUND CLEARANCE ..... 5.1 in

INTERIOR DIMENSIONS
PASSENGER VOLUME ..... **F:** 53 cu ft **R:** 43 cu ft
CARGO BEHIND ..... **F:** 41 cu ft **R:** 23 cu ft

CAR AND DRIVER TEST RESULTS

ACCELERATION

ZERO TO	SECONDS
30 MPH	1.8
40 MPH	2.5
50 MPH	3.4
60 MPH	**4.4**
70 MPH	5.6
80 MPH	6.9
90 MPH	8.6
100 MPH	**10.6**
110 MPH	12.7
120 MPH	15.4
130 MPH	18.4
140 MPH	22.4

tested by JOSH JACQUOT *in Chelsea, MI*

layout is an elegantly useful balance of dedicated buttons and screen functionality. And in case you're a carmaker wondering how to best integrate controls, let the Koreans give you a lesson in center-stack harmony—knobs on the audio system control volume and tuning, and two dials on the ventilation system manage cabin temperature. Another knob near the shifter adjusts drive modes. Curiously, there's no primary knob for the infotainment system, but Kia makes it all work with dedicated buttons.

The Stinger further closes the gap to high-end machinery with a strong showing of standard features. GT trims include LED headlamps, heated front seats, and Android Auto and Apple CarPlay integration, to name a few. If there's one piece of tech that most clearly demonstrates Kia's seriousness about chasing upmarket carmakers, it's safety. The Stinger's advanced safety features work seamlessly and intuitively. Lane-keeping assist, when coupled with adaptive cruise control, verges on hands-off-the-wheel automation even if that's not its intent. Lane centering is superb, and we found the system capable of managing lane shifts and high-speed sweepers with little to no driver oversight—not that we encourage it. The Stinger is not, however, as quiet as those compact premium sedans offering similar interior space. At 70 mph, our GT produced a 71-decibel din, louder than an Audi S5 Sportback, BMW 340i, and Jaguar XE.

In our testing, which included repeated lapping of our 10Best loop, we saw only 17 mpg from the Stinger, 2 mpg less than we measured in the 325-hp Ford Fusion Sport. EPA fuel-economy data wasn't available as of this writing, but we estimate the GT will hit 21 mpg combined.

True story: In 1989, the name Stinger graced a lime-green Pontiac concept car that was equipped with a garden hose, two car phones, and an attitude gyro.

Stinger pricing won't be finalized until it goes on sale this month, but our informed estimates say that rear-drive GT trims will start at $39,895, with all-wheel drive adding $2200. Our fully loaded rear-drive Stinger with advanced safety features is a $50,395 proposition if these prices stick. That's a lot of money for a Kia. Which leaves us asking: Is this hidden-hatch Kia worth $50,000?

Despite being quick at both going and stopping, the Stinger lacks the feel, finish, and immersive experience of the premium mid-size players. But it's without question a better car inside than, say, a Dodge Charger Daytona, which starts at a nearly identical price yet lacks the Stinger's performance. It comes down to what buyers want. If the exquisite experience of a true luxury sports sedan is a no-compromise zone, they'll have no choice but to shell out another 20 grand for a premium mid-sizer. But if a step down in finish and aura is acceptable, and if muscle is important, then the Stinger delivers speed in a package that looks as if it drove off an auto-show turntable.

ROLLING START, 5–60 MPH	**5.0**
TOP GEAR, 30–50 MPH	2.5
TOP GEAR, 50–70 MPH	3.2
1/4-MILE	**12.9 sec @ 111 mph**
TOP SPEED	167 mph (gov ltd, mfr's claim)

HANDLING

ROADHOLDING, 300-FT-DIA SKIDPAD	**0.93 g**
UNDERSTEER	MODERATE

BRAKING, 70-TO-ZERO MPH

SHORTEST STOP	**156 ft**
LONGEST STOP	162 ft
FADE RATING	NONE

WEIGHT

CURB	**4004 lb**
PER HORSEPOWER	11.0 lb
DISTRIBUTION	**F:** 51.9% **R:** 48.1%

FUEL

CAPACITY	15.9 gal
OCTANE	91 (recommended)
EPA COMBINED/CITY/HWY	21/18/27 mpg (*C/D* est)
***C/D* OBSERVED**	**17 mpg**

INTERIOR SOUND LEVEL

IDLE	39 dBA
FULL THROTTLE	84 dBA
70-MPH CRUISING	71 dBA

**Manufacturer's estimate.*

Shell V-Power NiTRO+ Premium Gasoline
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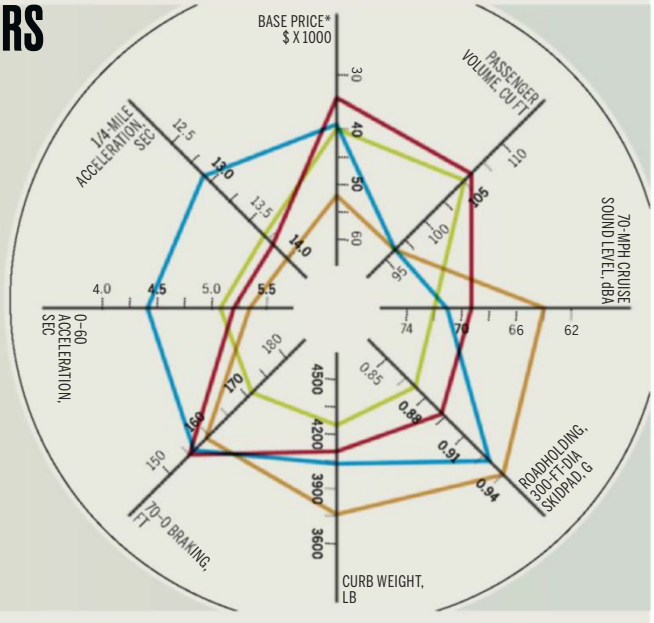
COMPETITORS

Cost and performance are the Stinger's greatest virtues. It plays well with our spider chart even if you don't. —

- **KIA STINGER GT** 3.3-L V-6, 8-SP AUTO
- **AUDI A5 SPORTBACK** 2.0-L I-4, 7-SP AUTO
- **DODGE CHARGER DAYTONA** 5.7-L V-8, 8-SP AUTO
- **FORD FUSION SPORT AWD** 2.7-L V-6, 6-SP AUTO

*Includes performance-enhancing options.



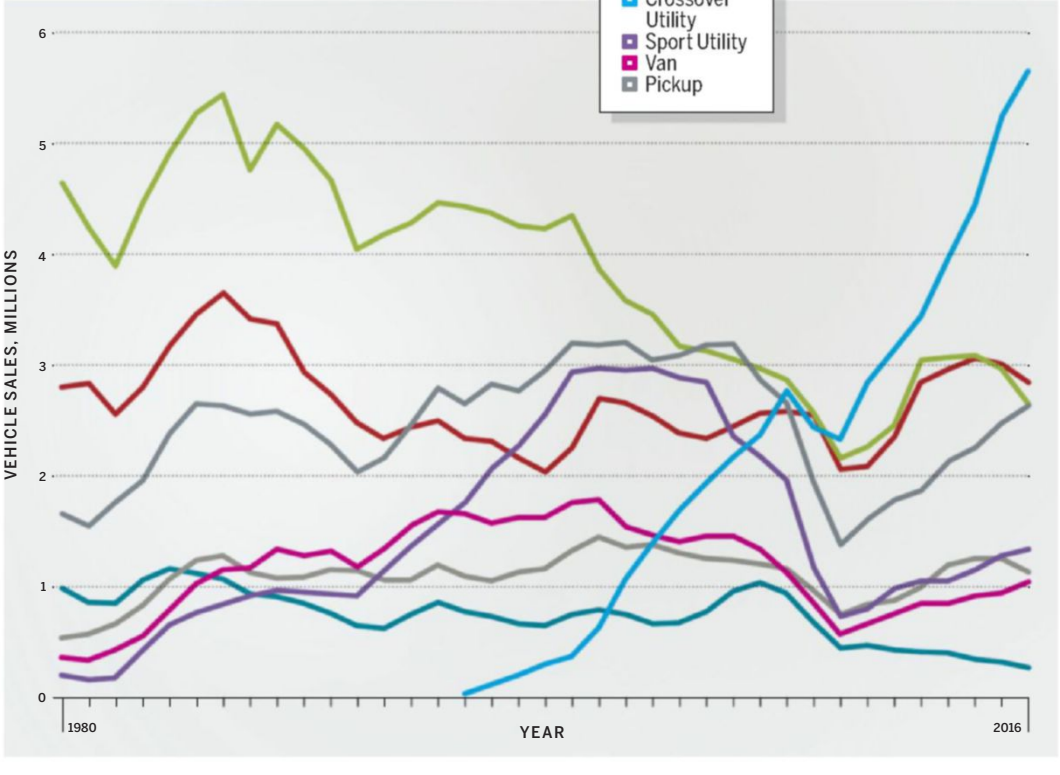
Saab In 1949, a Swedish aircraft maker began building eccentric little front-drive two-stroke cars. Saabs became progressively less weird, with the brand hitting its sweet spot in the '80s with the 900 Turbo and 9000 Turbo, the latter a four-time 10Best winner. Saab's noble experiment ended in 2010.

SALES

A LOOK AT HOW THE METAL MOVES.

by Clifford Atiyeh

U.S. vehicle sales data since 1980 confirm the changes we've witnessed on the roads. Mid-size cars are no longer the dominant mode of mainstream transportation. Buyers have been gradually moving away from them and into SUVs, causing a contraction of family- and mid-size-sedan sales. Pickup trucks remain ubiquitous, van sales neatly follow the popularity of the minivan, and the luxury segment has doubled. Since the source for our data, WardsAuto, began tracking car-based crossover SUV sales in 1995, the segment has grown to become the market's largest, roughly twice as big as the next closest, the small car. A record 17,465,020 new vehicles were sold in 2016, a number that's not expected to be matched in 2017.



Shift Interlock

SCANDAL When Audi owners started to complain of their cars leaping forward as they stood on the brake, the obvious explanation was that they were merely confusing the pedals. Part of the issue was Audi's use of a smaller brake pedal—rather than the wider brick-sized bars fitted to domestic cars in the 1980s—as well as the pedals' offset with the steering wheel. That didn't stop *60 Minutes* from airing a hatchet job with footage that cut between sobbing victims and an Audi 5000 that had been doctored to roll forward under its own power in a suitably dramatic fashion. Audi added to its automatics the now ubiquitous shift interlock, which won't allow the trans to leave park without a foot on the brake. And voilà! The runaway Audis stopped. NHTSA, in its 1989 report on unintended acceleration, exonerated Audi. None of that prevented a sales collapse, though, which nearly destroyed the brand's U.S. operations. Audi sold 74,000 cars in 1984 and just 12,000 in 1991.

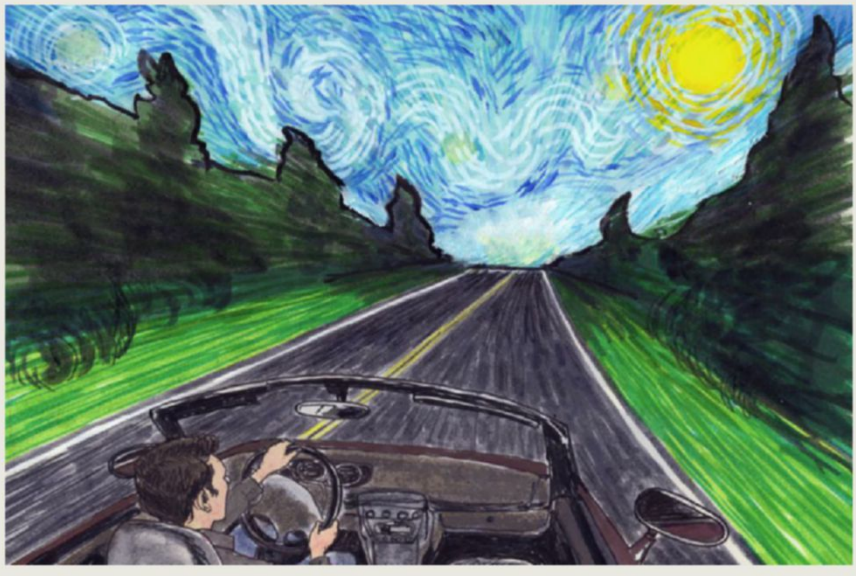
Sinners

See "Investigations."

Small-Block In 1955, Chevy introduced the small-block, a high-compression pushrod V-8. It displaced 265 cubic inches (4.3 liters) and had 162 to 195 gross horsepower. More than 100 million have been made, and 62 years later, the small-block continues to power Camaros, Corvettes, pickups, and SUVs. Today's version features variable-valve timing, direct fuel injection, and cylinder deactivation, and the only resemblance to the original is its signature 4.4-inch bore spacing.

Speeding

An ode to our favorite form of civil disobedience. by P.J. O'Rourke



Many are the blessings of the automobile: independence, mobility, freedom. But the greatest of these is freedom! While going too fast.

Speeding is art. At 120 mph, you're in Vincent van Gogh's *The Starry Night*. At 60 mph, you're in Ohio.

Speeding is poetry. "Triumphing over Death, and Chance, and thee, O Time," as John Milton, lead-foot-*avant-la-lettre*, put it in his poem "On Time."

Speeding is literature. "... a fast car, a coast to reach, and a woman at the end of the road," per Jack Kerouac.

Speeding is the source of America's greatest contribution to global culture—the car chase.

Without the car chase, the world would lack for touchstones of beauty, form, grace, and perception. The Keystone Kops. *Bullitt*. The Aston Martin DB5 in *Goldfinger* driven by the only real James Bond, Sean Connery. The happy ending of *Thelma and Louise*. *Mad Max*. *The French Connection*. *Smokey and the Bandit*.

The 1970s were the golden age of speeding. Credit goes to the two great patrons of the Speeding Arts, Richard Nixon and Jimmy Carter, who instituted and enforced the creative stimulus of the double-nickel speed limit [see "Autobahn of America, The"].

Even before that new limit was established, we witnessed the era's most moving (and fastest-moving) exhibition of performance art. The Cannonball Baker Sea-to-Shining-Sea Memorial Trophy Dash [see "C"] was composed and directed by *Car and Driver*'s own Brock Yates and Steve Smith and acted out between the Red Ball Garage in New York and the Portofino Inn in Redondo Beach. Running time: 35 hours, 54 minutes.

"Stay Alive—Drive 55" also brought speeding to the masses. Lowering highway speed to the pace of a fat arthritic cheetah let even the most timid and normally law-abiding American feel the rebel thrill of being Robert Mitchum in *Thunder Road*.

And it built character. Speeding was a moral commitment to nonviolent—unless you crashed—civil disobedience. Put the pedal to the metal and you were fighting for Truth (cars are fast), Justice (speed traps are bogus), and the American Way (way, way faster than 55 mph). Every speeder was a Mahatma Gandhi with the wind blowing through his hair, if Gandhi had had any hair.

But that was long ago. Now speeding is dead.

Speeding wasn't killed by police radar or laser guns or automatic cameras recording license-plate numbers. Speeding was killed by math. There are 2.7 million miles of paved road in the U.S. and 263.6 million registered motor vehicles.

When those vehicles are all on the road—and they all are—just look at the traffic! Divide miles of road by number of vehicles and the space you have to drive too fast in is 54 feet.

The problem was evident as early as 1994 in the O.J. Simpson white Bronco low-speed chase.

There are a few lonely country roads left. But they're full of hikers, joggers, bicyclists, and participants in Ironman triathlons. Fitness fanatics are swimming in the roads.

Yes, you can go to the track. And the hamster can go to its wheel. And the gym rat can go to his treadmill and dial it up to "the Flash." It's fun. But it's not freedom.

illustration by VIN GANAPATHY

----> AVOIDING UNWANTED ROADSIDE CONVERSATIONS SINCE CAR AND DRIVER ISSUE No. 448 ----> valentine One RADAR LOCATOR

Spy Photography

Carmakers try to keep future products hidden, and spy photographers try to expose them. Jim Dunne professionalized this cat-and-mouse game. by Tony Swan

Jim Dunne modestly dismisses the idea that he is the father of automotive spy photography, noting that various newspapers in the 1950s had printed snapshots of development prototypes from time to time before he elevated the game to a professional level. But in 1964, Dunne and modern spy photography got serious.

Employed at the time by *Popular Science* as its Detroit editor, Dunne had been augmenting his reports with photography of new cars as they were rolled out at official press previews. Dunne's shots of the second-generation Chevy Corvair were different; they were snapped from a covert vantage point overlooking the fence of the secured General Motors proving grounds in Milford, Michigan—a hideout later dubbed Dunne's Grove. The car was months away from its public reveal.

Dunne sent the shot to his *Pop Sci* editor and waited for a reaction. The editor wrote back: "Jim, it's electrifying. Can you send us more?"

Dunne was off and running. During his career with *Pop Sci* and later with *Popular Mechanics*, he expanded his client list and range of lurks. From standing hip deep in snow near Bemidji, Minnesota, in the middle of winter to enduring triple-digit heat in the Arizona desert, Dunne chased engineering drives and prototypes with dogged determination. To make his life a little easier, he acquired a parcel of land abutting Chrysler's Arizona proving grounds with a convenient view of the test track. It took a while before Chrysler caught on and erected a fence.

Since trespassing is against the law, if Dunne was confronted while working his camera in a place he couldn't legally shoot from, he avoided arrest by beating a hasty retreat. Dunne admits that he received occasional tips from carmakers as to where certain cars might be. But the tips were rare. Within the industry's public-relations operations, he was regarded as a sort of charming nuisance, tolerated but somewhat less than revered. GM captured the nature of this relationship with a jokey "Wanted" poster of him in the '80s.

While spy photography was always a professional sideline for Dunne—he never thought of leaving his day job as an editor—it became an exceptionally lucrative one. Dunne claims his extracurricular snapshots helped him put his seven kids through college.

It's rare for any successful new enterprise to continue as the sole province of its creator, and spy photography was no exception. After a few years, Dunne found himself surrounded by competition. And today, a smartphone makes anyone an amateur spy photographer. Now retired, Dunne, who turns 86 this month, still gives his cameras occasional workouts. But his days of hiding behind bushes, climbing trees, and being harassed by security guards are behind him.

The Waiting Is the Hardest Part

Shooting prototypes requires the patience to wait in the cold and heat. Dunne's reward for spotting a disguised 1984 Corvette outside GM's Milford proving grounds was our June '81 cover. Here's some of the big game nabbed by Dunne:

1984 Chevrolet Corvette

1997 Jaguar XK8

2004 Mercedes-Benz SLR McLaren

2015 Cadillac ATS Coupe

Supercharger
A compressor that feeds more air into an engine than it can take in on its own. The term has come to mean a compressor that is mechanically or electrically driven, but it technically includes exhaust-driven turbochargers as well.

PHOTOGRAPHY BY JIM DUNNE

illustration by FLORIAN NICOLLE

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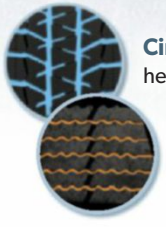

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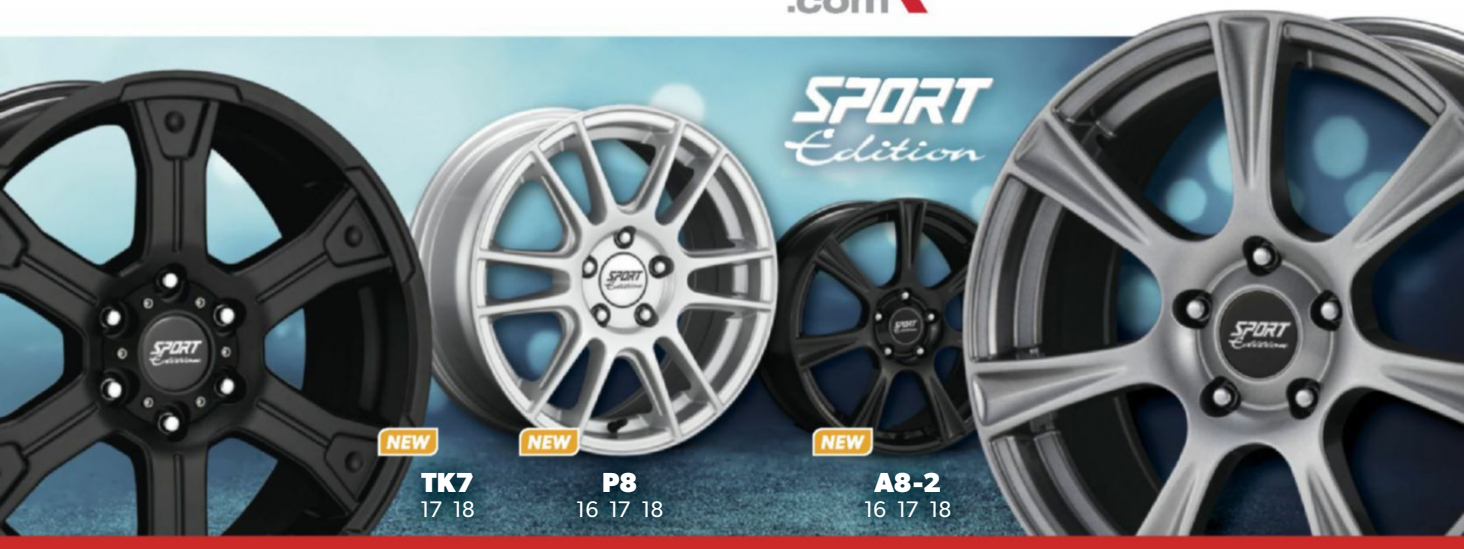

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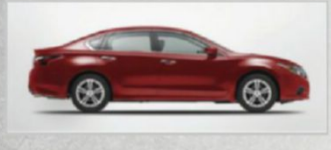

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10Best

Every year since 1983, we've picked our 10 favorite cars, creating an industry-standard award in the process. Here's a look back through the rearview mirror of one of the original winners. by Rich Ceppos

I'm behind the wheel of a 34-year-old Mustang GT. A soft burble from its V-8 lolls in the air. The tach needle lazily rises and falls as the manual shifter eases through all five gears. I'm rolling down Telegraph Road, not far from Ford's Dearborn, Michigan, headquarters. My destination is 1983.

That was a banner year for *Car and Driver*—and for Ford's pony car. It was the year we inaugurated our 10Best awards and voted the Mustang GT onto that first 10Best list. I was there, which is why I borrowed this all-original, 17,000-mile beauty from Mustang collector Mike Berardi: to take a pony ride back to the genesis of 10Best in one of the cars that won, for a look at how it all began.

This generation of Mustang was already in its fifth year when it was admitted to the 10Best class of 1983. Gas was a little over a buck a gallon, big hair was in, Ronald Reagan was president, and Michael Jackson had yet to destroy his legacy.

If you can remember 1983, the GT feels, well, a bit like you probably do—older, lazier, and stiffer. You sit tall, looking out through huge windows framed by thin pillars; the current Mustang is a bunker in comparison. The shifter throws are so long that you have to extend your right arm fully to engage fifth gear. At 50 mph, the GT shivers like a puppy in a thunderstorm. Road noise, wind rush, and the cacophony of the surrounding traffic drown out the mellow V-8. I don't remember it being this gritty back then; time and tide wait for no car, apparently.

The GT provides a lesson in how much we take for granted in today's cars. It lacks power-operated mirrors, windows, and seats. The interior contains enough shiny black plastic to supply a Lego factory. "Navigation system" meant a paper map in 1983, but there aren't any map pockets. Its safety gear includes not a single airbag. And where are the cupholders? If you'd grabbed a coffee from the McDonald's drive-through in '83, you would have had to keep it between your legs until you'd downed it.

Dipping into the throttle from a stoplight reveals that this Stang is more sound than fury. As the revs climb toward the tach's 5200-rpm yellow zone, the V-8's voice gets scratchy. The GT's engine, known for decades as the 5.0 despite actually displaying 4942 cubic centimeters, or 4.9 liters, sniffs through a four-barrel carb, belches exhaust through a restrictive catalytic converter, and develops a meager 175 horsepower at 4000 rpm. And that was a noteworthy improvement over the '82 GT's minuscule 157-hp allotment.

But thanks to 245 pound-feet of torque at 2400 rpm and a 3070-pound curb weight, the Mustang feels surprisingly lively and agile in normal driving. Back when it was new, we clocked its zero-to-60-mph time at 7.0 seconds, only a couple of ticks behind the quickest car we tested in 1982—the 220-hp Porsche 928, which did the 60-mph sprint in 6.8 seconds. Of course, by today's standards, the GT is a snail tied to a brick: A Honda Odyssey minivan will blow the stripe off the GT's hood in acceleration, cornering, and braking.

Still, the third-gen Mustang GT marked the start of a long climb out of the Dark Ages for American carmakers. Two oil shortages in the previous 10 years and the ratcheting up of emissions standards had diverted engineering resources into building smaller, more efficient cars. By 1983, though, the Camaro/Mustang performance race was on again. That rivalry was, like now, about more than just straight-line speed, so Ford also retuned the '83 GT's suspension for better handling and widened its Michelin TRX rubber for more grip.

Car and Driver was looking for more traction as well. Our legendary editor-publisher, the late David E. Davis Jr., was not content to captain the most literate, creative, outrageous, and technically astute car magazine of the time. He was consumed by a desire to pulverize the other car magazines—namely *Motor Trend*. The enemy had

1983 Ford Mustang GT*

VEHICLE TYPE: front-engine, rear-wheel-drive, 4-passenger, 2-door hatchback
PRICE AS TESTED: $10,816
BASE PRICE: $9449
ENGINE TYPE: pushrod 16-valve V-8, iron block and heads, 1x4-bbl Holley carburetor
DISPLACEMENT: 302 cu in, 4942 cc
POWER: 175 hp @ 4000 rpm
TORQUE: 245 lb-ft @ 2400 rpm
TRANSMISSION: 5-speed manual

DIMENSIONS
WHEELBASE: 100.4 in
LENGTH: 179.1 in
WIDTH: 69.1 in
HEIGHT: 51.4 in
PASSENGER VOLUME: 82 cu ft
CURB WEIGHT: 3070 lb

Car and Driver Test Results

ZERO TO 60 MPH: 7.0 sec
ZERO TO 100 MPH: 19.8 sec
1/4-MILE: 15.4 sec @ 90 mph
TOP SPEED: 125 mph (drag limited)
BRAKING, 70–0 MPH: 208 ft
ROADHOLDING, 200-FT-DIA SKIDPAD: 0.76 g

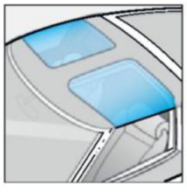
FUEL ECONOMY
EPA COMBINED/CITY/HWY: 16/13/21 mpg
C/D OBSERVED: 15 mpg

**Specs and results, June 1983.*

Shell V-Power NITRO+ Premium Gasoline
The Official Fuel of CAR AND DRIVER

Takata

SCANDAL An automotive supplier forced into Chapter 11 bankruptcy by its airbag scandal. Due to a defect, Takata's airbag inflators can rupture when deployed, releasing shrapnel. The final recall tally is likely to involve more than the 42 million vehicles already identified as being at risk. The airbags have been linked to 18 deaths and over 180 injuries, most in Hondas, though 19 automakers are affected. Three execs face charges for hiding the defect; Takata continues to crumble under the cost of the recall, lawsuits, and $1 billion fine.



T-Top

A stylish type of open-air roof with two removable panels that makes the car's driver 2.5 times more attractive. With both panels removed, the roof structure resembles a T, but it's also sort of like an uppercase I.

ILLUSTRATION BY PETE SUCHESKI

photography by GREG PAJO

its Car of the Year award—a promotional bonanza that brought it readers, ad revenue, and auto-industry recognition.

David E.'s counteroffensive was the editorial equivalent of shock and awe: Since *Motor Trend* crowned one car every year, we would anoint 10, making our award 10 times better! Then we'd demoralize the Trendies by adding nine more brilliant stories to the feature package.

Pointing the old Mustang west, I'm determined to do something we hadn't done 34 years earlier: drive it on *C/D*'s 10Best evaluation loop. None of the original 10Best winners were driven there. Why not? Because there was no loop. Well, it was there; we just hadn't discovered it yet, let alone hatched the idea of actually conducting an annual 10Best drive-off on it. Instead, we argued around the office conference table until everyone was disgusted that one or another personal fave hadn't made the final cut.

In '83, riding this white horse meant experiencing a 175-hp rush. The GT's 7.0-second sprint to 60 made it only 0.3 second slower than the '84 Corvette.

David E. imposed two stipulations on that initial 10Best: First, the cars couldn't be "hideously expensive." And second, we would choose five imported and five domestic models. He likely instituted those rules in the hope of giving the domestics a chance, and to remain on speaking terms with the Detroit car companies' execs and their advertising agencies. The appearance of a bias toward expensive imported cars—which were, as a group, better than the American cars of the day—surely would have made those important industry relationships more difficult.

Both rules were clearly stated in the 10Best Cars introduction. Readers didn't have any problem with them, but with American cars rapidly improving, the import/domestic quota disappeared. A price cap soon came into effect; we've used $80,000 in recent years, roughly 2.3 times today's average new-car price.

Rules or no, that first 10Best list included an eclectic group of cars: the AMC/Renault Alliance, Chevrolet Caprice Classic, Honda Accord, Mazda RX-7, Mercedes-Benz 380SEL, Pontiac 6000STE, Porsche 944, Toyota Celica Supra, Volkswagen Rabbit GTI—and the Ford Mustang GT. History has proved most of them worthy. And the Alliance support group still meets every Thursday.

Out on the 10Best loop in the GT, I pick up the pace gingerly; the Mustang's feathery steering doesn't send a single bit of information up through the spindly four-spoke wheel. I'd forgotten that. Diving into corners is unnerving, like groping for a cellar light switch in total darkness. With so little grip—we measured 0.76 g on the skidpad in 1983—and brakes that go soft after a handful of corners, it would be all too easy to sail Mr. Berardi's Polar White jewel off into the trees.

I do remember the rumba that the solid rear axle does over bumps, and how the GT's tail feints to the outside coming out of corners when you're hard on the throttle. At first, I'm just a tourist, but, slowly, my eyes and hands acclimate to the GT's outmoded controls and I'm a part of 1983 again, hanging the tail out and causing the rear axle to buck like a mildly annoyed filly.

The Mustang GT survived this exercise undiminished, as it had so many other floggings through the years. It is pretty much the car we remember—wieldy and willing but a bit edgy. In its day, it was a strong performer and a bargain at its $9449 base price. Since 1983, there's been steady improvement that's led us to the 460-hp 2018 Mustang GT, a car that retains the '83's essence and vitality while remaining relevant. We'd like to think the same of 10Best. Taking our cue from the Mustang GT, we'll keep at it.

T

Tesla

by Bengt Halvorson

Tesla might not exist if General Motors hadn't inspired protests by repossessing and crushing its EV1 electric car in 2003.

So says Tesla cofounder and CEO Elon Musk, a man who also plans to colonize Mars and carve tunnels through the earth. At times, Musk seems to embody the crackpot-visionary archetype, but his company has realized the only comprehensive vision for electric vehicles to date.

Tesla has proved that what's under a car's hood (and floor) is far less important to consumers than style, image, and performance. Its EVs are taken seriously by enthusiasts and luxury buyers alike, with eye-catching proportions, near-300-mile driving ranges, and sub-three-second zero-to-60 times. And it has smartly supported customers with a coast-to-coast network of Superchargers, a no-dealership model that mimics Apple's retail and support system, and over-the-air updates that can automatically add features and improve a car's performance.

Please spare us the word "disruption," though. While its stock valuation has surpassed Ford's and GM's, and premium brands are gearing up to take on the Model S and X, there are no signs yet of Tesla displacing the auto industry. The sector it comes closest to upending is the EV-battery business. Tesla is the world's largest buyer of lithium-ion batteries today, and with its newly opened Gigafactory in Nevada, the company wants to be the world's largest manufacturer of them. It's the cornerstone of Musk's plan to squeeze every last penny out of an EV's pricey battery via economies of scale and by controlling a larger portion of the supply chain.

The Fremont, California, facility that is Tesla's sole final assembly plant also owes its existence to GM. Once emblematic of nearly everything wrong with the Detroit automaker (labor issues, low productivity, poor quality), the plant got its act together when GM began a 25-year joint venture with Toyota there in 1984.

Tesla has more than a half-million $1000 reservations for the $35,000-to-$55,000 Model 3 that's starting to roll off the Fremont line. To speed the process, Musk skipped the prototype tooling stage—where the assembly hardware gets tested prior to vehicle production—and ordered the final equipment and started building. As Tesla tries to quintuple its yearly output, it'll be facing "production hell," as Musk describes it, to reach its goal of 500,000 vehicles in 2018. That's more than the plant has ever made annually in its 55-year history, and Tesla plans to double that quota in 2020.

Musk, who seems to relish the role of antihero, assessed Tesla's share price earlier this year as "higher than we have the right to deserve." If Tesla's investors and followers ever stop finding such behavior charming, or if Tesla fails to perform its ambitious production ramp-up, the automaker may still have trouble delivering the future vision it promised.

Tumblehome A design term with nautical roots; for a boat, it describes how the hull tapers inward above the waterline. In cars, it is used to describe the inward slope of the vehicle's glass area or greenhouse. An example of a car with a pronounced tumblehome is the Lamborghini Huracán; the upright Fiat 500L has precious little, which contributes to its minivan-ish look.

Turbocharger A supercharger that is powered by an exhaust-driven turbine. Automakers are using turbos more and more with smaller-displacement engines to increase efficiency.

TUMBLEHOME ILLUSTRATION BY T. M. DETWILER

Tesla illustration by EDDIE GUY

WeatherTech®

FloorLiner™
Provides “absolute interior protection™”
Laser measured to perfectly fit your vehicle
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United Auto Workers

Unionization brought affluence and power to the automotive workforce, but the union's influence is waning in the 21st century. by Jeff Sabatini

When Henry Ford's hired goons slammed union organizer Walter Reuther into the pedestrian overpass at the Rouge factory, the future United Auto Workers president probably wasn't thinking about speedboats. Or the trucks his members' children and grandchildren would one day use to drive to cottages on pretty little lakes in northern Michigan, pulling trailers laden with watercraft in the summer and snowmobiles in the winter. It would be several years before someone coined the phrase "He who dies with the most toys wins." But in 1937, the fledgling UAW was fighting, quite literally, for your right to party.

Reuther survived the beating at the Battle of the Overpass, just as he survived a shotgun blast through his kitchen window in 1948, an assassination attempt that was never solved but indicates just how powerful he had become. In the interim, Reuther had taken control of the UAW, a democratic socialist organization concerned not just with the welfare of its own members but with that of society at large. "We are not going to operate as a narrow economic pressure group which says 'We are going to get ours and the public be damned,'" Reuther said. "We want to make progress with the community and not at the expense of the community."

The UAW saw its successful campaigns for pension plans, annual wage guarantees, member health insurance, and productivity and cost-of-living adjustments create pressure for companies in other industries to follow the automakers' lead. Governmental safety-net programs such as Social Security and state unemployment insurance were expanded in the wake of UAW collective bargaining. And as Reuther's tenure continued through the 1960s, the union became even more active in politics with its support of the civil-rights movement and other liberal domestic policies of the Johnson administration.

But the UAW was always primarily focused on winning higher wages for its predominantly Midwestern blue-collar members, who, in the time-honored American tradition of wanting their children to do better, kept negotiating up for each successive generation. Measured in today's dollars and not including benefits, overtime pay, etc., the average autoworker's wages doubled from $367.04 a week in 1947 to $748.31 in 1960, and then tripled to $1104.67 a decade later, elevating most UAW members into the middle class. And of course this kept them buying TVs and the latest new cars, contributing to the Keynesian demand that Reuther and others believed kept the economy stable.

But by the early 1970s, the prosperity that the UAW had helped create and the détente between the union and the automakers began to break down. Reuther died in a plane crash in 1970, an ominous beginning to a decade in which changing market conditions brought on by the globalization of the auto industry threatened the domestic carmakers. This forced the UAW to change its focus from building a higher standard of living for its members to protecting the jobs and gains it had already won.

By the 1980s, the UAW was not only playing defense, it was also starting to shrink. Its numbers began a long slide, starting with a peak of 1.5 million members in 1979 and eventually bottoming out at just 355,191 amid the automakers' bankruptcies of 2009. The UAW is still a going concern, though its influence in American society has been largely decimated. Growing income disparities have put the lifestyle that so many blue-collar workers had grown accustomed to out of reach for today's workers.

Ford's in-house goon squad approaches UAW leaders moments before the Battle of the Overpass on May 26, 1937, just outside the River Rouge plant.

PHOTOGRAPH BY MPI/GETTY IMAGES

Uber
A meter-less taxi service where the drivers try to convince you that this isn't their real job.

→

Understeer
A condition that precedes slamming front end first into a barrier. It occurs when the slip angle of the front tires exceeds that of the rears. If you're steering and the car keeps heading straight, you're understeering. Also known as push.

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See "Leaded Gas."

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V Angle The angle between two banks of cylinders is a critical design factor in balancing an internal-combustion engine. The most common V angles for various engine configurations are:

V-4 180 degrees (flat-four)
V-6 60, 90, or 180 degrees (flat-six)
V-8 90 degrees
V-10 72 degrees
V-12 60 degrees

VECTOR

Wiegert's fantastical wedge highlights why we test cars in the first place. by Csaba Csere

Before the word "vaporware" existed, there was the Vector. The promises were big, the styling jaw-dropping, and a drivable production car elusive. That's the thing about vaporware—it's all too easy to be seduced by a great-looking body and assurances that it works as advertised. Vector struggled to build a production car in the '80s, but the W2 prototype enjoyed supercar mystique and street cred nonetheless. *C/D* was guilty of helping to foster that image. It started with a story in our December 1980 issue in which then associate editor Larry Griffin heaped praise on the car and its creator, Gerald Wiegert. But Griffin never drove the Vector. Arty shots on a dry lake bed helped make a car years away seem real.

The publicity that ensued made us Wiegert's best friend, but we never got a test car. Wiegert was a gifted designer who had drawn a remarkable shape, and his creation employed top-drawer components. But the '80s passed without the car coming together.

And then, in early 1991, we got a call. The company trucked two W8 TwinTurbos, which is what Vector called the production version of the W2, to our photoshoot. With a claimed 625 ponies from its twin-turbo 6.0-liter small-block V-8, the car indeed felt strong. But after we completed a few passes for photos, the red engineering prototype ground to a halt, its three-speed GM transmission having decided to stop sending torque to the rear wheels. We jumped into a gray prototype to head over to our desert test site, but even the tests that are easy on the engine (braking, top-gear, and skidpad) spiked the water temperature to 250 degrees. After cooling it for a few hours and adding water, we tried an acceleration run, which overheated the car and led to heavy engine knock.

Vector mechanics worked on the car the next day. We got in it again, and the engine started frying during the five-minute evening drive to an unofficial test venue, the nearby Terminal Island Freeway. With a flight the next morning, it appeared that we would not be testing the Vector. Wiegert desperately wanted a successful run. We told him to call if he got the car sorted.

At 2:30 a.m., the phone rang. Wiegert said his car was ready. We headed to Pershing Drive, a north-south road between LAX and the beach. The red Vector ran strong, stayed cool, and managed 60 mph in 3.8 seconds and a 12.0-second quarter at 118 mph. But all was not well. It may have gone faster, but the trans wouldn't shift into top gear, the engine was hitting a rev limiter short of its indicated 7000-rpm redline, and reverse disappeared. That was as close as we ever got to testing a Vector.

Building a car is hard, and big promises make the nearly impossible even harder. We would love to see cars like the Vector succeed, but we work hard to not let our optimism outweigh our skepticism of unverified claims. It's why we don't accept any manufacturer's numbers as gospel. It's also why we rigorously evaluate more than 700 cars a year. Don't believe the hype until it's driven and tested. The bigger the numbers, the harder they fall.

1991 Vector W8 TwinTurbo*

VEHICLE TYPE: mid-engine, rear-wheel-drive, 2-passenger, 2-door coupe
PRICE AS TESTED: $421,270
BASE PRICE: $421,270
ENGINE TYPE: twin-turbocharged and intercooled pushrod 16-valve V-8, aluminum block and heads, port fuel injection
DISPLACEMENT: 364 cu in, 5972 cc
POWER: 625 hp @ 5700 rpm
TORQUE: 630 lb-ft @ 4900 rpm
TRANSMISSION: 3-speed automatic with manual shifting mode

DIMENSIONS

WHEELBASE: 103.0 in
LENGTH: 172.0 in
WIDTH: 76.0 in
HEIGHT: 42.5 in
PASSENGER VOLUME: 50 cu ft
TRUNK VOLUME: 5 cu ft
CURB WEIGHT: 3680 lb

Car and Driver Test Results

ZERO TO 60 MPH: 3.8 sec
ZERO TO 100 MPH: 8.3 sec
ZERO TO 120 MPH: 12.4 sec
1/4-MILE: 12.0 sec @ 118 mph
TOP SPEED: 218 mph (mfr's claim)
BRAKING, 70–0 MPH: 191 ft
ROADHOLDING, 300-FT-DIA SKIDPAD: 0.91 g

FUEL ECONOMY

EPA COMBINED/CITY/HWY: 8/7/10 mpg

**Specs and results, May 1991.*

ILLUSTRATION BY T.M. DETWILER

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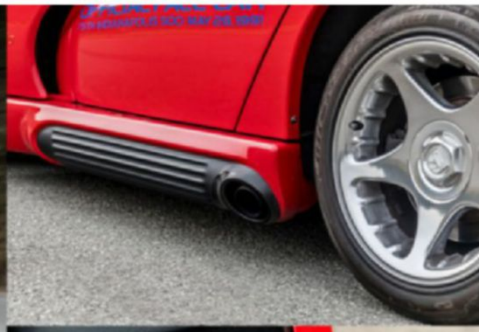


WARNING
Hot Exhaust Pipe Below Door Opening
AVOID CONTACTING THIS AREA

5BGZ391

Viper RT/10, Dodge

When something as dull as the K-car saves the farm, you have every right to go on a bender. by Davey G. Johnson

My number-one worry was spinning it into a tree. Second to that, fueled by a quarter-century's collective bench-racer wisdom on the Viper, was the fear that the car would be a shoddily whacked-together animal—no brains, all muscle.

And sure, the brake pedal of this 1993 Viper is so much higher than its accelerator that heel-toeing the thing would require some sort of quadruple ankle joint. The dashboard could only have been conceived with the help of the Fisher-Price design team. And your long-of-torso, five-foot, eleven-inch correspondent found the windshield's top frame exactly at eye level, precluding use of the Dodge's bikini top.

Exactly none of that matters. The RT/10, displayed as a concept in 1989 and fast-tracked into production for 1992, is fundamentally a first-generation Mazda Miata designed by a brass band's worth of star-spangled idiots. Every input is rewarded with a predictable output. The Dodge's six-speed shifter snaps into position with welcome precision. Its steering exhibits a magnificence that no modern car can touch; the steering wheel, with no airbag, speed-reads tarmac Braille and spits the translation directly into your hands. Brake feel could be generously described as wooden, but the binders never lack for power, and the modern Michelin Pilot Sport PS2 rubber fitted to later stock-size wheels on our test car help bring the proceedings to a quick halt.

Stoking the 488-cubic-inch V-10 begins with an inauspicious rumble through the Viper's side pipes and builds, via honking crescendo, into a jungle roar. Look around the windshield frame and through a left-hand corner, hit apex, apply throttle upon exit, look down through the glass at the upcoming right-hander, decelerate, thrill to the basso profundo overrun, repeat. Or just point the long nose at the horizon and let 8.0 liters carry you away.

A bold anachronism from the very beginning, the RT/10 is an elemental testament to the pleasure of mechanized movement. The Viper was far too weird to last 25 years without further refinement, but that doesn't stop us from concluding that the car in its original form was a paragon of bizarre perfection.

1995 Dodge Viper RT/10*

VEHICLE TYPE: front-engine, rear-wheel-drive, 2-passenger, 2-door roadster
PRICE AS TESTED: $61,975
BASE PRICE: $61,975
ENGINE TYPE: pushrod 20-valve V-10, aluminum block and heads, port fuel injection
DISPLACEMENT: 488 cu in, 7990 cc
POWER: 400 hp @ 4600 rpm
TORQUE: 465 lb-ft @ 3600 rpm
TRANSMISSION: 6-speed manual

DIMENSIONS

WHEELBASE: 96.2 in
LENGTH: 175.1 in
WIDTH: 75.7 in
HEIGHT: 44.0 in
PASSENGER VOLUME: 48 cu ft
TRUNK VOLUME: 5 cu ft
CURB WEIGHT: 3534 lb

Car and Driver Test Results

ZERO TO 60 MPH: 4.3 sec
ZERO TO 100 MPH: 10.5 sec
ZERO TO 150 MPH: 38.3 sec
ROLLING START, 5–60 MPH: 5.0 sec
1/4-MILE: 12.8 sec @ 109 mph
TOP SPEED: 168 mph (drag limited)
BRAKING, 70–0 MPH: 180 ft
ROADHOLDING, 300-FT-DIA SKIDPAD: 0.98 g

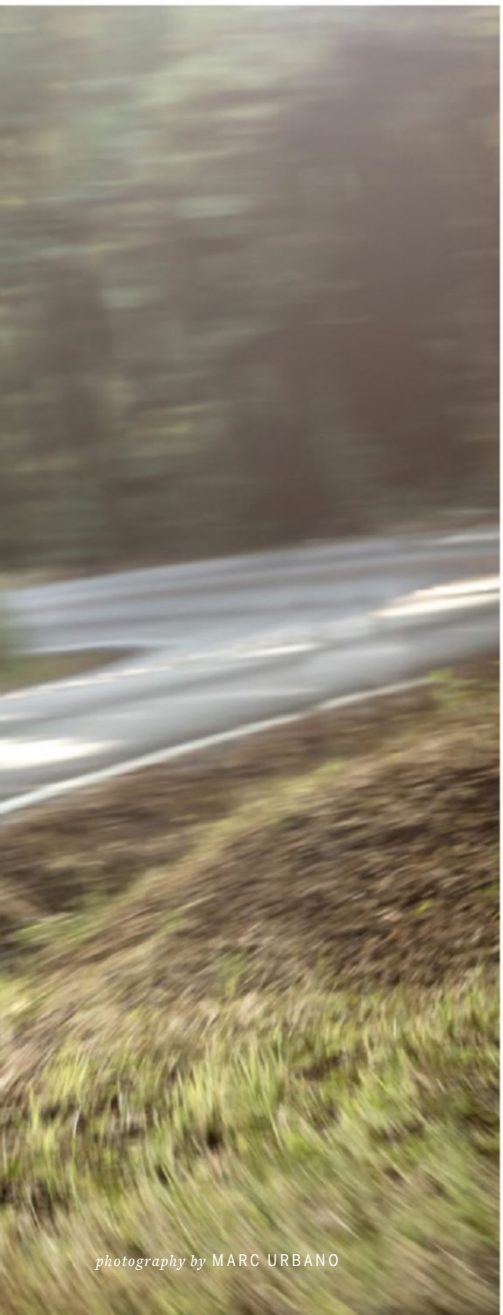
FUEL ECONOMY

EPA COMBINED/CITY/HWY: 14/11/20 mpg
***C/D* OBSERVED:** 14 mpg

**Specs and results, July 1995.*

Shell V-Power NiTRO+ Premium Gasoline
The Official Fuel of CAR AND DRIVER

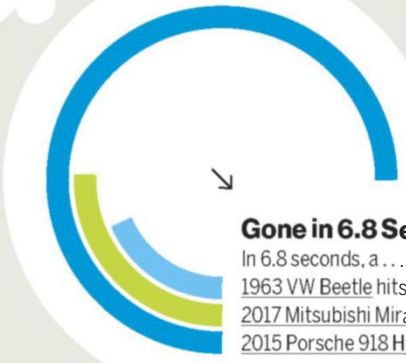
When Chrysler owned Lambo, the Italians helped modify a truck engine for sports-car duty; the Viper's V-10 had 100 horsepower on the Ram's.



photography by MARC URBANO

Volkswagen

Revisiting round and rectangular, we drive the people's car and the Boho icon. by Mike Duff


Gone in 6.8 Seconds
In 6.8 seconds, a . . .
1963 VW Beetle hits 30 mph.
2017 Mitsubishi Mirage G4 SE hits 41 mph.
2015 Porsche 918 Hybrid hits 121 mph.

The Beetle evolved steadily throughout its long life, as Volkswagen geeks will be glad to explain in excruciating detail. Windows got bigger, fenders became more rotund, and the windshield gained a curve sometime in the mid-1960s. Lights, the electrical system, and the air-cooled engines grew more powerful, and the suspension was redesigned. Yet to the casual observer, this 1978 example, carefully preserved by Volkswagen U.K. as one of the final German-built Beetles, looks pretty much identical to the KdF-Wagen that Hitler had ordered in the late 1930s to motorize the Third Reich.

That plan never unfolded, but the VW did survive both the war and the collapse of the Nazi regime that had commissioned it. This was thanks to several lucky breaks, the greatest being the inability of British automakers to see value in the car or the bombed factory that had produced it. A postwar report on the rear-engined oddball concluded, in what must have been said with a harrumph and plummy English accent, "The vehicle does not meet the fundamental technical requirements of a motorcar."

The Brits did restart limited production under military control, but it took civilian sales of what was officially known as the Volkswagen Type 1 to prove the breadth of the Beetle's appeal. In Europe, it became the utilitarian product Ferdinand Porsche had conceived it as, sold on the basis of value and reliability. But when imports began into the U.S. in 1949, the Beetle acquired a new aura, cleverly marketed as the antidote to the bloat and excess of domestic autos. In the '60s, its ad campaign by Doyle Dane Bernbach made a virtue of its simplicity and lack of pretension. It became a car for people who wanted to make a quiet point about not owning a fancy car, blazing the trail later followed by the Toyota Prius.

Much about a 39-year-old Beetle feels predictably dated, but an equal amount also feels impressively fresh, and not just because this immaculate museum piece has only covered 4100 miles in its life, still bearing a whiff of new VW smell. While its busy rear-engined soundtrack reminds us of a Porsche—the current 911 is a second cousin five times removed—performance is modest. This European-spec '78 has a 1.2-liter flat-four producing just 36 horsepower. (In '77, its last year in the U.S., the hardtop Bug had a 1.6-liter engine with 48 horses.) Although it is brisk enough to keep up with 21st century traffic, the Beetle lacks the firepower to draw ahead of it. Yet there's an enthusiasm to the way it drives that belies its official 36.0-second zero-to-60 time, the engine's rortiness and keen responses making it feel faster than it is. The Beetle is far from a sports car, but the gearshift is accurate, the clutch is progressive, and the steering offers good weight and feel. It drives with a positivity that's in stark contrast to the dynamic slop that characterized most of its early contemporaries. The brakes are terrible, though—but then, all brakes were pretty terrible in the 1970s.

When the Beetle hardtop left the U.S. market in '77, it had 48 horsepower, a claimed zero-to-60-mph time of 19.5 seconds, and a top speed of 80 mph. The 53-hp 1967 Bus topped out at 65 mph.

What's more impressive is the air of quality. The doors shut with a weighty thunk and the paint finish is good enough to put many modern cars to shame.

Our other period exhibit, a 1967 Type 2 Bus with a full camper conversion, is well equipped with a pop-up roof, a fridge, and even a kitchen sink. This one normally lives in the lobby of Volkswagen's British HQ, its odometer admitting to just 1169 miles in the past 50 years, and it's definitely better to look at, or to live in, than it is to drive. Performance is limited enough to make the Beetle feel sprightly by comparison. According to VW, the Bus will go to 65 mph, which makes zero to 60 more a test of patience than of speed. Hitting 50 mph feels positively daring. At that speed, substantial steering input is required to keep it traveling in a straight line; the gearbox has all the snap and precision of a chimpanzee sousaphone orchestra; the brake pedal is little more than a mushy footrest.

The Beetle turned Volkswagen into a global player and laid the groundwork for the company's rise into a globe-spanning automotive empire. More than 21 million were built, the last in Mexico as recently as 2003—that's five years after the so-called New Beetle, a front-driven retro pastiche of the original, had been introduced to the more credulous parts of the world. Yet while the original Bus sold in far smaller volumes, it was also a true pioneer—pretty much the first lifestyle vehicle. Let's hope that Volkswagen's new Bus, with an all-electric version to be launched in five years' time, has some of the same pioneering spirit.

photograph by CHARLIE MAGEE

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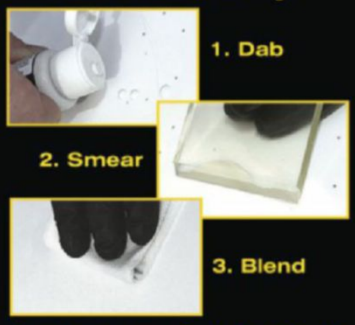

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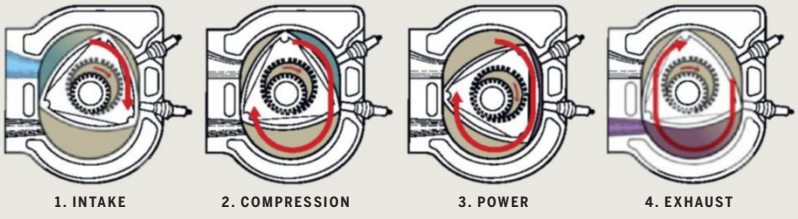


Wankel Engine Developed by Felix Wankel, this internal-combustion engine uses a triangular rotor that moves eccentrically inside an epitrochoidal chamber, which is roughly elliptical in shape. As the rotor turns, it simultaneously performs intake, compression, power, and exhaust strokes. Championed for years by Mazda, the Wankel engine's compact size, smooth operation, and simplicity are clear advantages, but oil consumption, production costs, and poor fuel economy have, as of now, sidelined it.

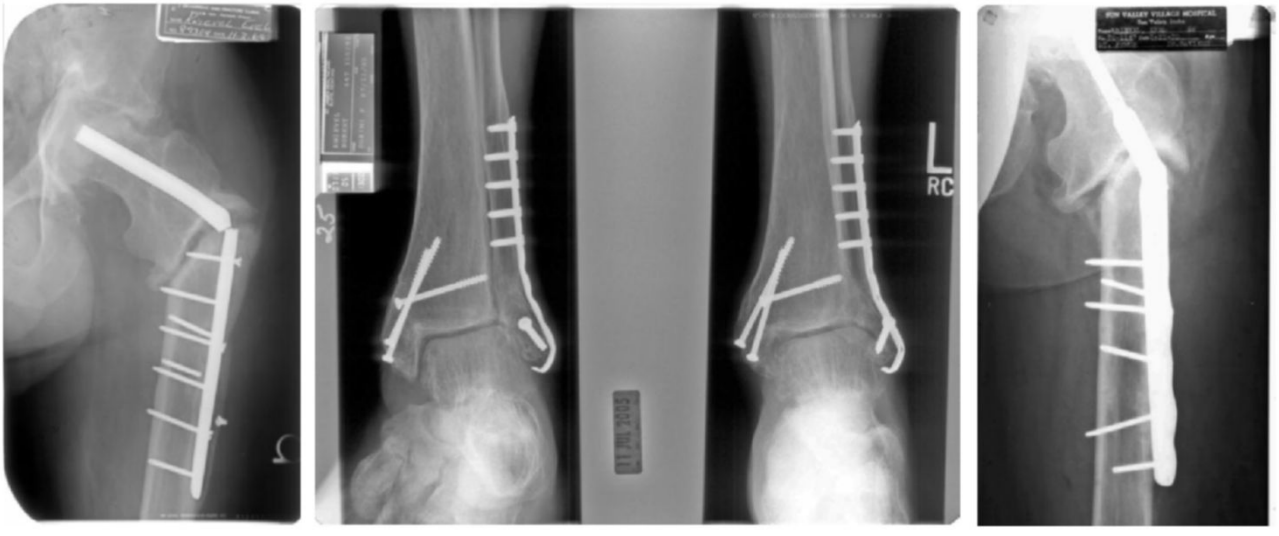
Yates, Brock
See "Cannonball" and "Editors-In-Chief."

Yaw
A rotation about the vertical axis that passes through a vehicle's center of gravity. Also, a condition that precedes slamming into an obstacle with the side of the car.

Yerba Mate
A soothing hot tea consumed by Ed.

X-Ray *A broken badass. by Tony Quiroga*

Born Robert Craig Knievel in Butte, Montana, Evel Knievel was undeniably the most celebrated stunt performer of the 20th century. Among his many famous jumps, two stand out: his attempt to jump over the fountains at Caesars Palace in Las Vegas in 1967, which ended in a bone-shattering crash, and his jump across the Snake River Canyon in Idaho on a steam-powered rocket, which ended with a parachute malfunction. Though Knievel suffered from a myriad of major injuries—he holds the Guinness world record for the most broken bones in a lifetime, at 433—his self-promotion, charisma, bravery, successes, and spectacular failures made him a household name, an antiestablishment hero, and a rich man. His long career left his body battered, broken, and held together with screws, plates, and other hardware as seen in this incredible series of X-ray images, but it was an incurable lung condition that took his life in 2007.



KNIEVEL'S X-RAY IMAGES WERE PROVIDED BY THE EVEL KNIEVEL MUSEUM IN TOPEKA, KANSAS. WANKEL ILLUSTRATIONS BY PETE SUCHESKI

Z

Yugo

by Jason Vuic, author of The Yugo: The Rise and Fall of the Worst Car in History

In May 1984, entrepreneur Malcolm Bricklin [see "B"] was in a bind. His venture, the importation of Pininfarina Spiders and Bertone X1/9s, was failing, and, facing bankruptcy, he had 120 days to find a more profitable car to sell here. So Bricklin scoured the world, traveling first to England, where he tried to land Jaguar, then to Serbia, a republic of what was then communist Yugoslavia. It was there, in the parking lot of Belgrade's Hotel InterContinental, that he and former Fiat executive Tony Ciminera first examined a Fiat-based hatchback called the Yugo.

"I'm looking at [the car] and I said, 'Ugh! This is really primitive!'" recalls Ciminera. But Bricklin was desperate. So the next day, he and Ciminera toured the Yugo factory, whose owner, the aptly named Crvena Zastava (or Red Flag) Works, also made machine guns. The building was dark, the floors greasy, and Ciminera was shocked to discover smoking workers stepping into cars with dirty shoes on and newly stamped fenders being thrown into bins. It was a disaster. But because the Yugo cost about $2000 wholesale, Bricklin figured he could cover the car's homologation and sell it stateside for just $3990, which he did in August 1985.

Although it was a communist-made car sold in Reagan's America, dealers had customers lining up 10 deep to buy one. Yugo America sold an astonishing 1050 cars in a single day. But what goes up must come down. There were serious quality issues. The car was slow, crawling to 60 mph in 14 seconds and topping out at 86 mph. Then came the reviews. *C/D*'s then technical director, Csaba Csere, wrote, "It's obvious to me that the Yugo GV is inferior to every other car sold in America."

The hits kept coming. The car performed poorly in crash tests, sales plummeted, and soon everyone was ripping on it: *Saturday Night Live*, Leno, Letterman, *The Simpsons*. Kids told jokes about it, and one dealer in Philadelphia offered a "Toyugo" sale, but most buyers refused the free Yugo that came with the purchase of their Toyota. The end came in 1992, when, during the Yugoslav civil war, Yugo America went bankrupt (for a second time), and the United Nations issued a trade embargo on Serbia that included Yugo parts.

1986 Yugo GV*

VEHICLE TYPE: front-engine, front-wheel-drive, 4-passenger, 2-door hatchback
PRICE AS TESTED: $5458
BASE PRICE: $4379
ENGINE TYPE: SOHC 8-valve inline-4, iron block and aluminum head, 1x2-bbl Carter-Weber 740
DISPLACEMENT: 68 cu in, 1116 cc
POWER: 55 hp @ 6000 rpm
TORQUE: 52 lb-ft @ 4600 rpm
TRANSMISSION: 4-speed manual
DIMENSIONS
WHEELBASE: 84.0 in
LENGTH: 139.0 in
WIDTH: 60.7 in
HEIGHT: 54.7 in
PASSENGER VOLUME: 80 cu ft
CARGO VOLUME: 6 cu ft
CURB WEIGHT: 1860 lb

Car and Driver Test Results

ZERO TO 60 MPH: 14.0 sec
1/4-MILE: 19.5 sec @ 68 mph
TOP SPEED: 86 mph (drag limited)
BRAKING, 70–0 MPH: 202 ft
ROADHOLDING, 300-FT-DIA SKIDPAD: 0.68 g
FUEL ECONOMY
EPA COMBINED/CITY/HWY: 25/22/29 mpg
***C/D* OBSERVED:** 25 mpg

**Specs and results, April 1986.*

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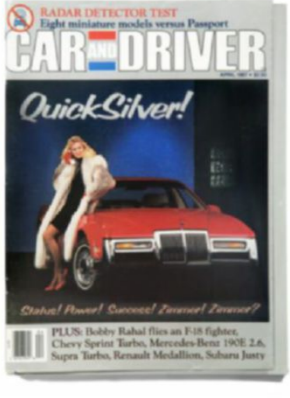
RADAR DETECTOR TEST
Eight miniature models versus Passport
CAR AND DRIVER
QuickSilver!
PLUS: Bobby Rahal flies an F-18 fighter, Chevy Sprint Turbo, Mercedes-Benz 190E 2.6, Supra Turbo, Renault Medallion, Subaru Justy

CAR AND DRIVER
THE NEXT BIG THING!
MINI-UTES
Suzuki's new X90...
...and the Toyota RAV4, Chrysler Back Pack, Ford Fusion, Hyundai HCD-III.

Zimmer

Hindsight is 20/20, especially when it comes to our covers. The Chevy Citation turned out to be more revolting than revolutionary. Putting a Zimmer on the cover was our way of saying cocaine is a hell of a drug. And while mini-utes did turn out to be the next big thing, the Suzuki X90 was not. But we saved the worst for last . . .

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What I'd Do Differently

Otis the Avocado

PORSCHE'S NEW HITE THE 911 CARRERA 4
CAR AND DRIVER
CALIFORNIA COOLERS!
The convertible you've always wanted —and 34 others— beginning on page 34.
Plus: Nissan's new 240SX. Suzuki Swift GTi. Beretta vs. Beretta shoot-out. Hyundai Excel. Honda Civic Si. A convertible truck. Truck!

→ Appearing on the February 1989 cover of *Car and Driver* at the wheel of a Buick Reatta convertible, the world's most beloved anthropomorphized avocado tells us about his turn in the spotlight, his triumphant life post-cover, and how he is in no way related to, inspired by, or in any way similar to the California Raisins™. *by Daniel Pund*

C/D: ***Many who were on staff back in 1989 claim they weren't aware of the plan to photograph you in the seat of the Buick Reatta roadster for the cover. In fact, most of the staff was pretty embarrassed by the whole thing.***

OtA: Look, there were certain, shall we say, arrangements. *A-range-ments*, okay? But, look, you don't see any of the other cover subjects having the career I've had. You didn't call up that poufy-haired shirtless guy who posed on the cover with the Suzuki X90, did you? How about that fur-wearing hussy you had pushing her rump against that Zimmer? Yeah, that's what I thought. Also, an X90? What the hell, man?

■ ***Is there any particular reason why you looked so sedated during the shoot?***

☐ Next question.

■ ***Many readers thought you were actually a personified pistachio nut or maybe an unusually happy rotten potato.***

☐ Oh, right! Because pistachio nuts can drive!

■ ***But, as you know, ripe avocado skins aren't light green. Only the flesh is. Were you asked to pose before your time or were you asked to take that off?***

☐ Nope.

■ ***So going green was your idea?***

☐ Nope.

■ ***But you didn't wear one of those little tuxedo-style bibs/dickeys like the California Raisins™ did.***

☐ Oh, here we go. The California Raisins™. Can we just move on from them?

■ ***But this is the first time we've even mentioned the California Raisins™.***

☐ Okay, smart guy: Did you know that those little dingleberries were just lip-syncing? Buddy Miles sang all that for 'em. Bunch of Milli Vanilli raisins, if you ask me. But you probably didn't know that, did you? You just sat there on your mama's couch all smug in your stupid Coca-Cola rugby jersey singing along, "Heard it through the grapevine . . . " When I did something, it was all Otis, champ, because Otis is a professional. Let's move on.

■ ***But your creation was, after all, just a cynical ploy to latch on to the inexplicable popularity of Claymation commercial spokesfruits acting like an R&B band, right?***

☐ Pretty simple, man. You have raisins and you have avocados. Different things. Not the same. Get it?

■ ***But what about the palm tree and the sunset and the fact that the cover said "California Coolers!"? Wasn't that just an obvious rip-off?***

☐ [*Long silence.*]

■ ***We noticed that you were referred to in the magazine as Otis the Avocado as well as Otis Mulholland? What's with the two names?***

☐ Never heard of a stage name? They weren't supposed to use Mulholland in the magazine. I think one of your writers was a fan of my work. I do some videos for a production company out of the San Fernando Valley. That's my stage name for, shall we say, alternative film work.

■ ***We hear you've fallen on some hard times recently. That you've been charging strangers $10 to take photos of you sitting in their cars out in front of the motel where you live.***

☐ Yeah, man, I can't lie. Otis has seen some tough times. It was a party, my man. Hoo! But you know, the party's gotta end, and when it does, you wind up a lonely avocado, divorced two times, getting a little softer with age, and the fertilizer, man, the fertilizer. You try a nice N-P-K balance a few times, then pretty soon you find yourself up to 46-0-0, just pounding the nitrogen. Eventually, I was taking Miracle-Gro with me into the bathroom at Walmart. But am I on anything now? Yes, I am. I'm on Otis.

■ ***What about the Reatta convertible? Did you enjoy that car?***

☐ I was more of a Chrysler's TC by Maserati man myself. But I'll tell you what. A lot of people don't know that I was instrumental in the development of that car. You remember the hardtop version of that Regatta [*sic*]? Well, it had that TV screen in it instead of buttons, lookin' all glowing green like something out of *War Games* or something. You know, "Shall we play a game?" and all that. Anyway, do you have any idea how hard it is for a guy like me to work that thing? Look at my hand, man. I've got four big-daddy sausages here, and these gloves don't come off. I can't work those tiny TV-screen buttons. Anyway, while I was at that cover shoot, I talked to the Buick guy, the one in the teal polo shirt, and said, "Man, this is not going to work!" And he said, "For 1990, we've got a more traditional dash. You're gonna love it!" And, sure enough, they did. So there you go.

■ ***Is there anything you'd do differently?***

☐ Yeah, you know, I should have rubbed a little lemon juice on me every day. Just like anyone should. But shit, I'm famous. What do I care? What am I going to take back? The marriages? The parties? I mean, I'm an aphrodisiac, man. Enough said.

illustration by FLORIAN NICOLLE

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MENS JEWELRY

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